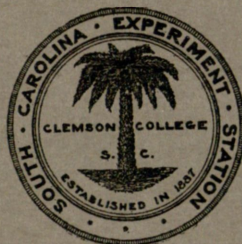


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Forty-First Annual Report
OF THE
South Carolina
Experiment Station
OF
Clemson Agricultural College

H. W. BARRE, Director



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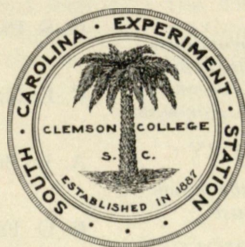
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STATE DOCUMENTS

FOR THE YEAR ENDED JUNE 30, 1928
Clemson College, S. C. December, 1928

Forty-First Annual Report
OF THE
South Carolina
Experiment Station
OF
Clemson Agricultural College

H. W. BARRE, Director



FOR THE YEAR ENDED JUNE 30, 1928
Clemson College, S. C. December, 1928

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A. S. LAIRD, *Agent (Forage Crops)*

Letters of Transmittal

Clemson College, S. C.,
November 19, 1928

Dr. E. W. Sikes, President
Dear Sir:

I have the honor to submit herewith the Forty-first Annual Report of the South Carolina Experiment Station for the fiscal year ended June 30, 1928.

Very truly yours,

H. W. BARRE, Director.

Clemson College, S. C.,
November 19, 1928

Hon. Alan Johnstone, President Board of Trustees,
The Clemson Agricultural College.
Dear Sir:

I beg leave to submit herewith the Forty-first Annual Report of the South Carolina Experiment Station, which in accordance with the law, must be submitted to the Governor on or before February 1, 1929.

Very truly yours,

E. W. SIKES, President.

Clemson College, S. C.,
November 19, 1928

Hon. John G. Richards,
Governor of South Carolina.
Sir:

I have the honor to submit herewith the Forty-first Annual Report of the South Carolina Agricultural Experiment Station in accordance with the requirements of an Act of Congress, approved March 2, 1887, for establishment of Agricultural Experiment Stations in connection with colleges of the several states, organized under the provisions of an Act approved July 2, 1862.

Respectfully submitted,

ALAN JOHNSTONE,
President Board of Trustees.

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The
FORTY-FIRST ANNUAL REPORT
of the
South Carolina Experiment Station

INTRODUCTION

No state or country can have a safe and permanent agriculture without the kind of diversification which will insure a certain, constant, and adequate income. The ideal program of diversification is one which provides many sources of income so as to permit a choice of enterprises to meet fluctuating prices and offset unfavorable seasons. The agriculture of South Carolina is becoming more diversified each year. As this diversification increases farm problems multiply and the need for additional agricultural research increases.

The research work of this Station has furnished a basis for much of the diversified system now practiced in this State. Our breeding and feeding experiments with dairy cattle have laid the foundation for the rapid development which is now taking place in the dairy industry. Carefully conducted experiments made at this Station with forage crops and supplementary feeds laid the foundation for large numbers of successful demonstrations which have been conducted in the feeding and shipping of hogs. The pasture researches and experiments with methods of wintering beef cattle at the Coast Station and at Clemson College have formed the basis for the development of profitable beef cattle production. Our forestry experimental work at Drainland is developing principles of management of cut-over pine lands which will be of untold value in the reforestation which the State is just now beginning.

While we are fortunate in having been able to work out definite scientific principles upon which these lines of diversification are being built, there is still much to be done with reference to other lines of production. South Carolina is fast becoming an important vegetable and fruit state. The physiological, ecological, and biological factors fundamental to the successful and economic production of many of our fruits and vegetables must be developed through scientific research. These lines of investigation which are necessary for maintaining and increasing these new enterprises and strengthening our diversification program, are being undertaken at the Sand Hills and Coast Stations.

With the increase in diversification comes the need for definite information on the consumption and demand of the various products and the need for the development of marketing systems which will

insure proper and efficient distribution. The researches in agricultural economics are giving us a different viewpoint on many of the enterprises in a diversified agriculture. We must not only be able to grow a crop but we must be able to market it at a profit if we are to succeed. The consumer-demand studies, the cost-of-production studies, and the farm organization studies which have been completed are giving valuable information which is enabling our farmers to make plans for the future with much greater assurance of success than has been the case in the past when many of their programs were based on very temporary conditions and changes and on unsound theories or too meagre economic information.

The research workers must therefore not only work out the scientific basis for production of a great variety of crops and animal products but must also develop the economic aspects of these problems to the point where the proper farm organization and the proper selection of enterprises can be made to insure a well-rounded and prosperous agriculture and a satisfying rural life. It is along these lines that our work is planned. Space does not permit any lengthy discussion of activities and results here. A more detailed report is being issued in separate form and will be available to all who wish to receive it. A list of projects being pursued and a statement covering the fiscal affairs of the Station will be found at the end of this report. Brief reviews of the several major divisions of research are made in the sections which follow.

RESEARCH WORK IN AGRICULTURAL ECONOMICS

It is the aim of the Agricultural Economics Division to develop farm organization and management which will provide a foundation for a more profitable rural life over a long period of time, and at the same time to apply available results to meet rapidly changing conditions. Examples of accomplishments along these lines are to be found in bulletins already published and in data which are being accumulated on incomplected projects.

Farm surveys were begun in this State even before the passage of the Purnell Act. Bulletins 221 and 230 issued by this Station undertook to discuss the factors affecting farm income and to recommend programs of organization and management. Accurate records now being kept by farmers in the same areas covered in the studies reported in these bulletins bear out the accuracy of our interpretations. In advance of the planting season of 1928 this Station issued Bulletin 246, "The Year Ahead in South Carolina Agriculture." This bulletin reviewed the outlook for agriculture in 1928 and made suggestions for meeting the problems which appeared inevitable. Now that the season is almost passed, it is gratifying to know that our conclusions were substantially correct. These are

only a few examples of the type of work which we are endeavoring to do for our farmers.

Cotton Marketing Study Of The State

The object of our research project in cotton marketing is to determine the actual grade and staple of cotton produced in different areas, to collect and interpret price data, to study the demand for cotton of different kinds, and to find out the general conditions prevailing in our different markets with respect to competition, monopoly, quality, and other factors. The South Carolina Experiment Station was the first one in the South to undertake research work along this line, through its Agricultural Economics Division, and already has three years of results on the price studies for the Anderson, Greenwood, Spartanburg, Orangeburg, and Sumter markets. At the close of the last fiscal year arrangements were made with the Federal Bureau of Agricultural Economics to continue this on a broader scope, to include practically all of the angles stated above in the objectives. The work is rather evenly divided between the Piedmont and Coastal Plains regions.

This is part of a broad study being undertaken by several other southern states in cooperation with the assistance of the Federal Bureau of Agricultural Economics. The Bureau is furnishing one field man, Mr. E. R. Torn, who makes his headquarters at Sumter, and this Station furnishes one field man, Mr. H. A. White, who is a Clemson graduate and has his headquarters at the College with the Agricultural Economics Division. Both men are equipped with cars so that they can cover their respective areas about once every two weeks. Approximately eleven percent of the entire cotton crop of the State is being sampled and officially graded, about 75 gins being included in this project. Price studies are now being made at five markets and yield-quality studies at two markets.

The economic importance of this problem is great and is well appreciated by the farmers and mill operators. Splendid cooperation in the study is being realized on all sides. The average production of cotton in the State over a period of years averages around one million bales. More than two million acres of land are annually devoted to this crop out of a total land area for the State of about twenty million acres, ten million of which are in farms and five million in crops. About fifty percent of the crop land is in cotton. Cotton is handled and marketed very unscientifically. There is much yet to be learned about the marketing and the quality of our leading cash crop from these research studies.

Seven thousand samples of cotton with price records and other data were secured in 1925, 1926, and 1927. These were graded by the official classers of the Federal Government. The discrepancies in grade were very great, the principal reasons being ignorance as

to correct grading and close buying on the part of the local buyer. All of this will probably be changed when the correct grading methods for cotton are widely disseminated and the facts of supply and demand are known better by both producers and consumers. Complete files of price and other data from the central markets such as Augusta and Atlanta are being collected. The long-time cotton price studies already begun will be helpful also. The first three years of results are about ready for publication.

Marketing, Demand, and Production Study of Charleston Farm Trade Area

These farm trade area studies have as their objective the pointing out to the farmers in the area the opportunities discovered by careful analysis of the local supply and demand of farm produce and securing of production records from the farmers themselves. The Charleston study is of the same type as those already made at Greenville and at Columbia. It shows the deficits and surpluses particularly of local perishable products such as are apt to prevail around a growing city, and how farmers can make the most out of the situation. Four counties were included in the study, most of the farm records being obtained near Charleston in the trucking area.

The Federal Bureau of Agricultural Economics assisted us in making this study and men in the bureau have gone over the manuscript which gives the results. The Charleston Chamber of Commerce also cooperated with the Station, providing office space for the workers and giving financial assistance towards the field work. Professor A. M. Carkuff of the Station has been in charge of this project.

Charleston is the largest city in South Carolina and serves a very important trade area. It is the center of an important trucking area, the truck type of farming extending over parts of several counties which come together in this vicinity. Charleston has a port that in relative rank among the ports of the United States has risen from thirty-second to fourteenth place since 1923. The city is the distributing center for a large area and provides a local market for all of the high grade whole milk, cream, eggs, beef, and pork produced in the area. Besides approximately four million dollars worth of truck products being shipped out of the area, considerable amounts of truck products are shipped into the area between truck production seasons. These points illustrate the size of the problem and the importance of farmers having the facts as a guide for the management of their farms in such a way as to meet the market needs in the best possible way.

Detailed records were obtained on fifty truck farms and about fifty general farms, the latter being located in the upper part of the



Fig. 1.—Next to Irish potatoes, cabbage is the most important cash enterprise of the Charleston area farmers.

area. Railroad and steamship records for the year 1927 showed that the following amounts of different products were shipped into Charleston in the year: 515,378 pounds of pork by water; 590 cars of packing house pork and beef products by rail; 15,116 pounds of lard and lard substitutes by water and 160 carloads by rail; 107 mixed cars of poultry and eggs; 17 cars of eggs; 2,100 pounds of butter by water; 55,783 pounds of butter substitutes by water; 46 carloads of dairy products, about 85 percent being butter; 5,200 gallons of sweet cream; and 1,619 carloads of feed. Although most of the whole milk supply comes from Charleston and Dorchester Counties, twelve Orangeburg County dairy farms, two in Florence County and two in Darlington County ship sweet milk to Charleston daily. The bulletin covering all the results will be available soon and will give detailed tables on all phases of the study.

The value of this study is that it provides correct information on which to base a program for the farmers in a general way. All farms are clearly distinct as units and the same program will not apply to all; what this investigation shows is how to best take advantage of the different economic opportunities existing. From rail and steamship records, interviews with business men and cooperative marketing associations and analyses of more than one hundred farm

businesses, recommendations as to what crops and livestock to raise for the most profits will be made so that farmers in the area can use the material as a guide in production. In addition, suggestions for the most profitable organization of individual farms will be made from studies of the most successful farms and experimental data. It is hoped that this may be followed some day by more detailed farm management and cost studies on the truck farms.

Marketing, Demand, and Production Study of Columbia Farm Trade Area

The objective in the study of the Columbia area was the same as in that of the Charleston area just described. Six counties were included. The Federal Bureau of Agricultural Economics and the Columbia Chamber of Commerce cooperated with the Station in this project. The Bureau furnished one man for about six months. Columbia is the second largest city in the State and is growing rapidly. It is the center of a large trade area. There is much cheap land in this area. About six distinct types of farming prevail, cotton, truck, dairy, poultry, cattle, and diversified including asparagus. Columbia has eleven separate lines of railway radiating in all directions, providing good transportation facilities and it has a busy curb market.

Complete tabulations were made of all incoming and outgoing farm produce so far as was possible. A large number of farms were surveyed. The market situation was discussed in last year's annual report. The manuscript has now been published as Station Bulletin 243. In it are found a number of tables indicating the results in detail. A few quotations from the summary are pertinent. "The fact that since 1880 the population of Columbia increased over 500 percent suggests the possibility of agricultural economic problems such as maladjustment of supply and demand". "Particularly were the deficits of locally raised vegetables noticeable". "In supplying Columbia and other markets with these different food products, farmers in the area work out different systems of farming; and at least five leading types are evident". The bulletin gives the investments, expenses, receipts and profits realized for each type under usual conditions.

"Above all, the market demand and comparative prices are an important consideration as regards what an area will produce on its farms". "Expanding production of a commodity beyond this market demand would at once create a market problem". The percent returned on the investment for the different types of farms was found to be—cotton 8.2, truck 13.7, poultry 11.5, cattle 8.3, and diversified 8.4. All of these returns are calculated on a cash outlay basis and consider productive capital only.

The Business Side of Dairying

A study of dairying and the markets for dairy products was made in order to determine the general place of dairying in South Carolina agriculture and the more efficient methods of producing dairy products under farm conditions. One hundred and fifteen dairy farm records and 375 usual farm records for different areas in the State, were secured. All possible statistics relating to dairying, together with price information, were collected.

The Federal Bureau of Agricultural Economics cooperated with us in securing many of the field records, experiment stations of South Carolina, Georgia, Alabama, and Mississippi and the Bureau having studied together two years ago the question of the economic place of livestock in the Coastal Plains region. The Dairy Division of Clemson College lent all possible aid to this project and went over and offered very helpful suggestions on the manuscript before it was published.

While the dairy enterprise is of minor importance in the State's agriculture, statistics show some tendency toward increased dairy farming in recent decades. Over a longer period, dairying has not kept pace with the growth of our local population. South Carolina in 1925 ranked as the thirty-fourth state in the number of dairy cows. She had that year 163,233 milk cows, while Wisconsin led with 1,904,869 head. The business side of dairying is important in showing the reasons for our relatively low demand, in indicating the best paying practices, and in analyzing the market factors.

The comparative advantages for dairying are enjoyed to the greatest extent by those areas having large local markets, good pastures, and cheap feeds. Consideration of these three factors explains the great concentration of dairying in the northeastern fourth of the United States and gives suggestions which may be helpful in the South in aiding dairying to overcome obstacles and make progress. There are marked seasonal trends in the prices of sweet milk and butter. By adapting the breeding and feeding to the price situation through the year, a dairy farmer can make more money; these are things he can do if he wishes. About 8,000,000 pounds of butter and butter substitutes and 40,000,000 pounds of canned milk are shipped into South Carolina annually.

Piedmont dairy farms had an average of about \$2,450 invested in the herd and equipment; grew about 23 percent of the feeds consumed by the cows; fed about 1.6 tons of concentrates, 2.3 tons of roughages, and 0.8 of a ton of succulents per cow per year; and secured about 600 gallons of milk per cow per year. The Coastal Plains dairy farms had an average investment of about \$5,000; grew about 26 percent of the feeds; fed about 1.6 tons of concentrates, 1.3 tons of roughages, and 0.8 of a ton of succulents per cow per year; and secured about 625 gallons of milk per cow per year.

The costs and incomes varied a great deal from farm to farm. The Coastal Plains has higher yields of corn than the Piedmont, while hay yields are similar in the two areas, and the Piedmont has more cities and towns as markets for dairy products. A large number of tables showing statistics, expenses, yields, pastures and other factors, is included in the report just published in connection with this study (Station Bulletin 249).

It is important to think out the economic theory as well as get the facts with respect to dairying. The progress of local dairying depends greatly on competition with the dairy states which have a number of advantages, competition with cotton and other enterprises locally, market demand, relative prices, and efficiency in production. A greater consumption of dairy products is considered desirable for the health of our people. Better quality to encourage more demand is first necessary to bring this about. The average consumption of dairy products per capita per year on the Piedmont farms was—milk 46 gallons, butter 26 pounds, and buttermilk 30 gallons; on the Coastal Plains farms—milk 28 gallons, butter 27 pounds, and buttermilk 44 gallons. City studies we have made indicate that the per capita consumption in town is only about 32 gallons of sweet milk per year. The present outlook for dairying is favorable. It is necessary to apply the outlook in the light of our local farming and economic conditions. The fact that many people in the State in the last decade lost money by plunging into dairying too rapidly makes it evident that the various angles of the economic side of this business as touched upon above can be studied with profit. There is considerable demand for detailed cost-account studies of dairy herds and it is hoped that this work may be carried on.

Farm Management Account Book Study of Piedmont Area

The purpose of this project is to determine the more profitable systems of farming from year to year. This study is based on daily records of a number of typical Piedmont farms, and continues in a way the Anderson farm management surveys. The work was done in cooperation with the Federal Bureau of Agricultural Economics. Mr. B. A. Russell of the Station continues in charge of this project. In the past fiscal year about forty farms kept records; these include the more earnest farmers but make up a fair sample. The records include all the expenses and receipts from the different crop and livestock enterprises.

The economic importance of having reliable input and output data for each enterprise is well recognized; this material provides a basis for intelligent adjustment by the farmer to changing prices and costs. Results for the calendar year 1927 were published as a mimeographed report largely on the basis of a comparison of the

best, average, and poorest paying farms. The principal reasons for the greater profits on some of these farms were the comparatively large acreage of cotton per farm and per mule, the intensive cultivation, the heavy use of fertilizer, and the efficient employment of labor. No detailed results will be given here, as the Division is working up a report on the results of the project during the last two years.

Farm Management Survey Study of Pee Dee Area

The object of this study is the same as in the earlier Anderson County surveys, where five years of records, totalling in all about a thousand, were collected. The project aims to provide material for a basis for more profitable farming systems for the Pee Dee, one of the best farming areas in South Carolina. Approximately 400 records have already been collected for the years 1925 to 1928, with some for 1919 and 1923 collected by the United States Department of Agriculture made available to us. It is planned to secure 100 more records and prepare the bulletin immediately.

The characteristics of the Pee Dee and the progress up to 1927 were given in last year's annual report. Since that time, about 100 additional complete records were obtained. Collection and tabulation of weather data and all possible crop and livestock statistics for the area since 1870 have also gotten well under way since last year. The survey itself is confined to six counties, but statistical material for eight counties—Sumter, Lee, Darlington, Marlboro, Dillon, Florence, Marion, and Horry—are being compiled. If funds permit, it would seem wise to follow the surveys with an account-book study in this area as is being successfully done in the Piedmont.

Studies of Farm Land Prices and Ownership

Probably about no economic question is there more incorrect thinking than about land. This is due mainly to the lack of understanding of land's part as an agent in production and the general relationships of supply, demand, and price of all commodities. Something as to the scope and the results of this work were given in the annual report of last year. This study has been carried on with the cooperation of the Federal Bureau of Agricultural Economics, Division of Land Economics. The objective in our land project has been to secure results which will indicate to the farmer—

1. Movements in land prices
2. What is the basis for the value of land
3. How to profit rather than lose by land-price changes
4. What is an economic land-utilization program
5. What is an economic land-holding basis

The average investment of a Piedmont farmer is about 55 percent in land (see Figure 2). Coastal Plains farm investments are somewhat the same. Land, therefore, makes up more than all other items put together. Further emphasis for the need of studying land may be given by reason of the general incorrect thinking with respect to the supply of and demand for land and the methods of employing it for human society. Other points indicating the size of this problem were outlined in last year's report.

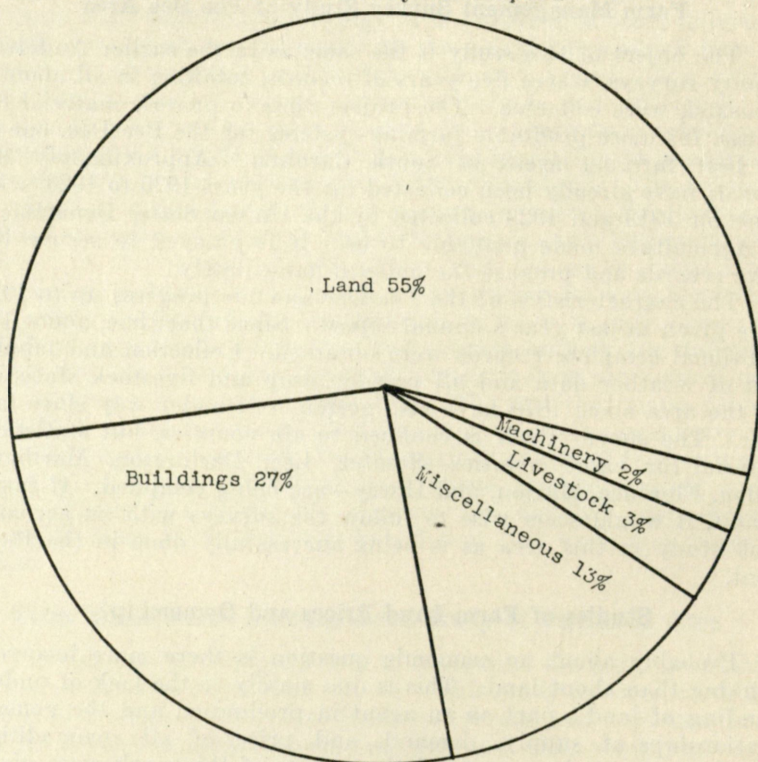


Fig. 2.—The average farm investment in the Piedmont is about \$12,000 in the case of four-mule farms; about 55 percent of this is in land.

Results to date have been published as Station Bulletin 247, based on special studies in Anderson, one of the leading agricultural counties in the United States. This bulletin contains a large number of detailed curves and tables. A long gradual rise in land values began in 1905, by 1915 reaching an apparently higher level than ever before. There is indication of cycles or movements in land prices corresponding to those of cotton. The average weighted

price of land sold in the prewar years, 1911 to 1915, was \$44.90 per acre; in the boom years, 1916 to 1920, it was \$89.17; and in the post-war years, 1921 to 1925, it was \$54.29 an acre. "In the brief period of the boom, five years, most of the catastrophe was begun - - -". The relationships of the price movements of land, cotton, building materials, clothing, and other items are traced in Bulletin 247.

Cyclical peaks in land prices were reached in 1895, 1899, 1902, 1907 to 1909, 1912 to 1914. The short fluctuations in price were eliminated by using a twelve-month average.

Movements in land prices correspond with those of cotton but show a lag of one to four years. While land prices show relationships to several factors as causative, cotton value seems to have most influence of all. There is some relationship to rent, which is really the annual market value of a farm. "In 1924 a study of 146 Anderson farms showed the weighted average cash rent to be \$9.42 per crop acre and \$5.38 per farm acre. If this rent be capitalized, assuming the usual rate of interest to be eight percent, the value of the land would be \$118 per crop acre. The value per farm acre on the same basis would be \$67. The sales data show an actual average sales value in 1924 of \$57 per farm acre. The two values are not expected to check exactly because price levels are changing slightly all the time. Many of the general applications of economic theory were verified by this study and are very important in a practical way.

1. High rents are caused by high prices, and not vice versa as is often stated; this is explained by the marginal and differential principle of land use, the best economic grades always being used first.

2. It is not economic to preach either intensive or extensive cultivation at all times. The best-paying practice depends on relative prices. "For example, during periods when land prices are relatively high and fertilizer and labor prices are comparatively low, it will pay to economize on land, farming intensively by increasing the application of fertilizer and labor to the same or even reduced amount of land". But, in other periods, the price situation is reversed, and then the economic procedure would also be different.

3. Land is a commodity like all others. It can be "over-produced" in the sense of there being too much of it in use in proportion to society's needs.

4. The seeming paradox of a small crop being worth more than a large one is in reality a correct economic law, and overexpansion of land often is the cause of surpluses with their low values per unit of produce.

5. The value of land is for the most part determined by the net value of the things it produces. This is the main factor, although speculation and other things have minor influences.

A better knowledge of the economic side of the whole land problem, a discussion of which is attempted in Bulletin 247, is vital to the intelligent transacting and utilizing of this great agricultural resource. It is planned to continue this project in cooperation with the Bureau to secure yearly land price indexes for several important farming areas in the State. This would provide a guide to wiser handling of land, particularly in periods of stress such as the farmers have been going through during the last ten years.

Credit Study of the State

In the last year's report a brief outline of the purposes and results of the credit study was given. Since that time, all tabulations of the records of farmers, bankers, and merchants have been completed, in all about thirty large sheets. Some of the many items tabulated include farmer's self-sufficiency, cost of credit from different sources, periods of loans, uses of credit, investments and returns.

The Farm Outlook in South Carolina

This is a new line of work undertaken by the Division of Agricultural Economics. We now have a considerable quantity of data as regards farm and market data. Unless this material is so utilized each year with current supply and demand and price information, much of the value of it will be unused. It is generally recognized that the proportion of the enterprises on a farm, as well as the practices in conducting each enterprise, must change as the prices of the products and of the cost goods change, if the best results are to be realized. The object of this study is to utilize the facts we already have, with additional price data, and interpret all of this so as to provide a timely guide as to the economic outlook for crops and livestock and as to what organization of a farm in different areas of the state will pay best. This must be done in the winter of each year before farmers make their plans for planting. By using this material, farmers can form the best possible judgments as to what changes, if any, in the proportions of their various enterprises or in the methods of conducting each one are likely to prove profitable.

The scope of this study depends mainly on the number of farm management records available. At present, about 1,000 Upper Piedmont and 400 Pee Dee records are completed; we also have enough truck records from the Charleston area for this work. It is necessary to know, for any area on which a forecast is to be made, the typical practices and what results can be expected when different applications of labor, fertilizer and other goods and services are made. In the report for last year, the first one made in the State, farm set-ups were worked out for the Upper Piedmont and the Pee Dee areas. In

Price of
Middling
New Or-
leans spot
Cents a
pound

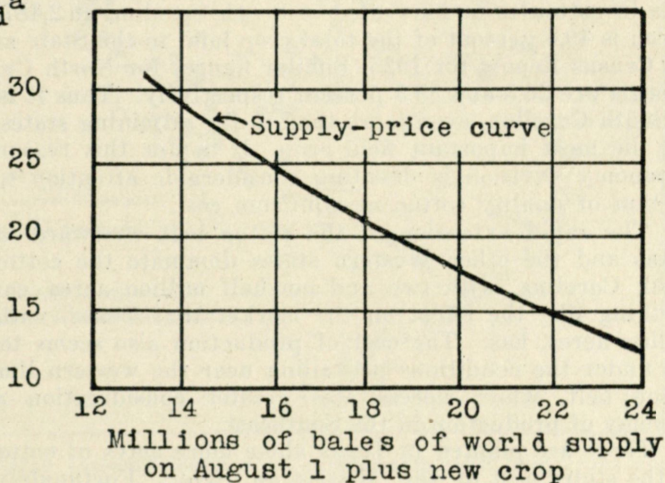


Fig. 3.—Graphic illustration of the relationship between the price of cotton and the supply.

addition to farm cost and income records, extensive studies of statistics of supply and demand and prices and other economic material must be made before an outlook can be set up which will be reasonably sound.

In the year 1927 the workers were assisted by leaders in different parts of the country in outlining outlook work, the details of which are numerous and involved. The plans were then tested out and in the months of December and January of last fiscal year the Division of Agricultural Economics spent most of its time preparing its first outlook report, published in February as Station Bulletin 246, "The Year Ahead in South Carolina Agriculture". Some of the principal topics discussed in this bulletin are the present position of agriculture; the outlook for South Carolina farm products,—cotton, tobacco, sweet potatoes, Irish potatoes, peaches, feeds, hogs, beef cattle, dairy products, poultry products, and miscellaneous products; type-of-farming areas in South Carolina and factors determining these types; organizing the farm for the greatest profits,—Piedmont cotton farms and Coastal Plains cotton-tobacco-hog farms; statistical appendix. The appendix brings prices and index numbers of what farmers sell and buy up to date. Business condition indicators are also given.

EXPERIMENTS WITH FIELD CROPS AND FERTILIZERS

Despite the development in diversification of crops in recent years, cotton continues to dominate the agricultural interests of the State. The government report for October 1, 1928, estimates the area in cotton to be harvested in South Carolina at 2,487,000 acres, which is 49.4 percent of the total crop land in the State as given by the Census Report for 1925. Similar figures for North Carolina and Georgia are 26.8 and 35.5 percent respectively. Thus it is seen that in South Carolina, even more than in the adjoining states, cotton is yet the most important field crop. It is for this reason that the Agronomy Division is devoting considerable attention to the production of quality cotton at minimum cost.

The rapid extension of the cotton belt westward means that Texas and the other Western states dominate the cotton market. South Carolina, with two and one-half million acres, cannot have anything like the effect on the market that Texas, with eighteen million acres, has. The cost of production also seems to be much less under the conditions prevailing near the western limits of the cotton belt, which necessitates greater consideration as to the economy of production in the Southeast.

There are planted in Texas alone more acres of cotton than in all the states east of the Mississippi River. Fortunately for the Southeast the farmers of western Texas and Oklahoma have not as yet been able to produce cotton of as great a length as one inch. As the majority of the mills of South Carolina demand a staple of from 15-16 to 1 1-16 inches it would appear that this is the length of staple we should strive to produce. Thus is our two-fold problem—the production of quality cotton at minimum cost—indicated. Many of our research projects are designed to give information as to how this may best be done.

With as diverse soil and climatic conditions as South Carolina, it is obvious that field experiments conducted in one section may not be applicable to the entire State. If information with which to aid in the solution of the many agricultural problems is to be available, experiments must be conducted in the various sections and soil areas. As commercial fertilizer is one of the principal items of cost of the field crops grown in the State, it is especially necessary to conduct fertilizer experiments on the several soil areas. The Agronomy Division has field experiments, in which various phases of fertilizer treatments are investigated, in 27 of the 46 counties of the State. These tests have been located with a view of studying the fertilizer and fertility problems of the most extensively grown field crops near their centers of production. Figure 4 shows the location of each of these experiments.

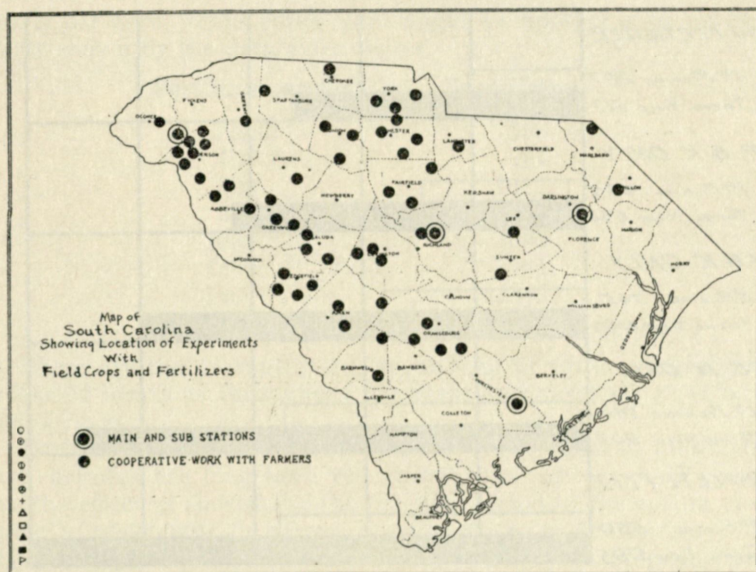


Fig. 4.—Map showing location of experiments with field crops and fertilizers.

Cotton Fertilizer Experiments

The soils of South Carolina are, almost without exception, deficient in the three plant food elements, phosphorus, nitrogen, and potassium which are usually considered as those supplied by a complete fertilizer. Thus is the application of complete fertilizer justified for practically all crops grown in the State, but all crops do not require the three in the same ratio or proportion. It is necessary to conduct experiments with the various analyses on the several prominent soil types in order to determine just what is the proper ratio and amount of fertilizer to use under the existing conditions.

Most Efficient Analysis.—For a number of years the Agronomy Division has conducted tests on the most extensive soil types of the State to determine the relative need for the different fertilizer constituents in cotton production and also the proper balance of the three plant food elements supplied by a complete fertilizer.

Figure 5, which is also published in South Carolina Experiment Station Bulletin 245, gives a summary of certain results secured in a number of tests conducted during the past several years.

This clearly shows the need for complete fertilizer in the economical production of the cotton crop. From this chart it will be noted that no fertilizer produced, on an average, only 517 pounds of seed cotton per acre, and the application of a fertilizer contain-

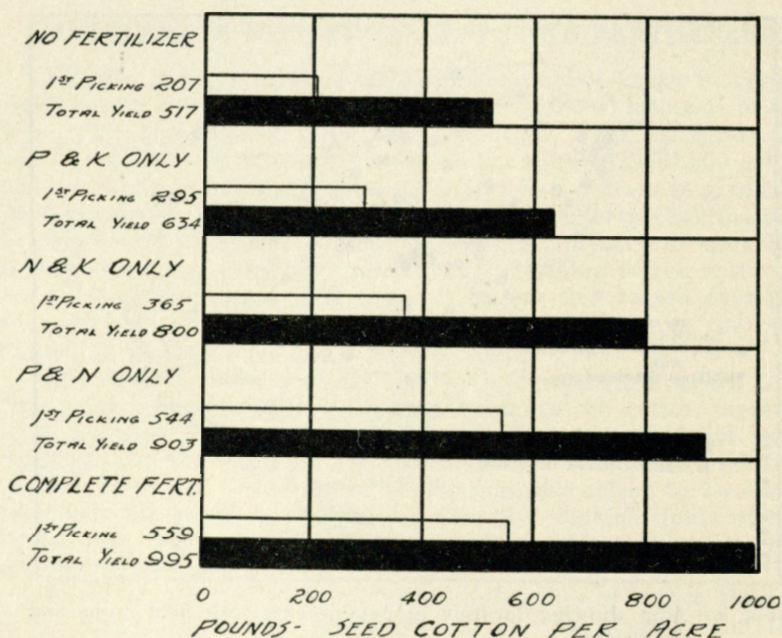


Fig. 5.—The effect of various fertilizers on yield of seed cotton.
Average results from cooperative experiments, 1920-1927.

ing only the mineral elements, phosphorus and potassium, increased the yield to but 634 pounds of seed cotton per acre. Where nitrogen and potassium were used the average yield of seed cotton per acre was 800 pounds, and where a fertilizer containing nitrogen and phosphorus was applied the yield was 903 pounds of seed cotton per acre or only 92 pounds less than the 995 pound average yield secured where a complete fertilizer was applied.

One may conclude from this that nitrogen is the first plant food element which proves a limiting factor in the production of cotton in South Carolina, with phosphorus next. The need for potassium is not so pronounced, but it is necessary when the need for the other two elements has been met. It should be recalled that the cost per pound of the three plant food elements is not at all the same. The cost of potash is very low as compared with the cost of nitrogen, and therefore a small increase in yield may justify the addition of potash to the fertilizer for cotton.

Rate of Application.—Practically every acre of cotton planted in South Carolina receives some fertilization, but in the majority of cases the rate of application is far below that which is most profitable. The average applied to cotton for the State in 1928 was 320

pounds per acre. That much more might be applied with profit, is clearly shown by the data given below.

Fertilizer per Acre	Seed Cotton
None	560
400 Lbs	871
600 "	1012
800 "	1080
1000 "	1096
1200 "	1161
1400* "	1245

* Not represented in all tests.

These are the average yields secured in 37 different trials in a number of locations throughout the State and covering a period of several years.

Earliness as Affected by Phosphorus.—The effect of phosphorus upon earliness has long been recognized, and as the boll weevils have the effect of shortening the fruiting period of the cotton plant, the use of phosphatic fertilizers is made all the more necessary. Not only is the yield increased by heavier applications of phosphorus, but the earliness of the crop is also hastened. This is illustrated quite clearly by the following figures:

Phosphoric Acid	Percent at First Picking
None	45.6
2 *percent	49.3
4 "	50.6
6 "	53.9
8 "	56.3
10 "	55.2

* Not represented in one experiment.

These results represent an average of 42 trials where the application of nitrogen and potash was kept constant, but where the phosphoric acid was varied.

The rate of application in these tests was on the average approximately 700 pounds per acre. These data indicate that as much as 55 to 60 pounds of phosphoric acid may be used to advantage in hastening the maturity of the crop, but that larger applications, under the conditions of these trials, do not have any material effect upon earliness. Increasing the percentage of phosphoric acid in the analysis to 10 percent had the effect of slightly increasing the total yield, however.

Cooperative Work with Farmers.—The 1928 season has been very bad on the experimental work located in the eastern section of the State, but on the whole satisfactory yields are being secured.

Results are not available, as picking has not been completed as yet. The first picking in the experiment on Messrs. Fletcher's farm in Marlboro County gives some very interesting information as noted below.



Fig. 6.—Cooperative fertilizer experiment on farm of W. B. and J. A. Fletcher, Marlboro County.

At the first picking made on October 2, the unfertilized plots following corn and soybeans produced an average yield of 615 pounds of seed cotton per acre as compared with 275 pounds from the unfertilized plot following cotton. The plots receiving 800 pounds of a 10-0-4 fertilizer produced a yield of 555 pounds of seed cotton per acre as compared with 1680 pounds produced on the plot receiving the same amount of phosphorus and potash with an additional application of ammonia sufficient to make the total analysis 10-9-4. That potash was needed is indicated by the fact that the yield was increased approximately 200 pounds of seed cotton per acre by the addition of 6 percent potash to the 800-pound application of 10-6-0.

Nitrogen Fertilizer Tests.—The one fertilizer ingredient about which most interest is centered at the present time is nitrogen, or as usually expressed in fertilizer terms, ammonia. Not only is this the most necessary plant food element in our mixed fertilizers, the one in which our soils are most deficient, and the one most easily leached from the soil, but it is the most expensive as well. The source and amount of nitrogenous plant food largely determines the cost of the mixed fertilizer.

Numerous tests are conducted by the Agronomy Division in order to determine the most economical and satisfactory sources of

nitrogen as well as the best time and rate of application. These tests largely take the form of field trials and are conducted in a number of places throughout the State. No less than twelve experi-

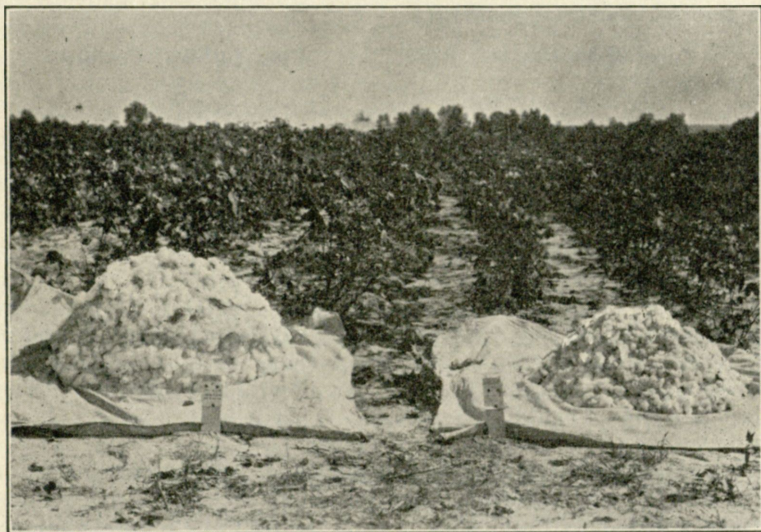


Fig. 7.—Source of nitrogen for cotton Experiment in Greenville county, 1928. Plot on left received 600 pounds of 10-6-4 per acre (35 percent of nitrogen from cottonseed meal, 65 percent from leunasalpeter). Plot on right received 600 pounds of 10-0-4 per acre.

ments with the time and rate of application of nitrate of soda to cotton in as many counties have been conducted this year. Results are not available at this time, as picking has not yet been completed.

The experiment conducted at Clemson College to determine the most efficient source of nitrogen for side application to cotton has been continued as before. An average of five years' results shows that an application of 100 pounds of nitrate of soda in addition to the regular fertilizer has given an average yield of 1178 pounds of seed cotton per acre as compared with a yield of 1169 pounds from an equivalent application of sulphate of ammonia. This would indicate that under the conditions of the test, the two materials are of approximately the same efficiency, there being less than one percent difference in the average yields for five years. Without any additional side application the yield of seed cotton was 1009 pounds per acre, or an increase of 169 and 160 pounds of seed cotton per

acre, due to the nitrate of soda and sulphate of ammonia respectively.

The data presented below give the results secured from increasing the rate of application of nitrate of soda to cotton, when all other factors remained constant.

Quantity per Acre	Pounds Seed Cotton
No side dressing	917
50 pounds Nitrate of Soda	961
100 " " " "	988
150 " " " "	1024
200 " " " "	1056
250 " " " "	1064
300 " " " "	1140

It will be noted that each successive application of readily available form of nitrogen in the form of nitrate of soda resulted in an increased yield of cotton. On the average each 50-pound application of nitrate of soda as a side dressing increased the yield of seed cotton approximately 37 pounds. This is a very profitable increase, even at the present price of cotton.

The best time to make side application of readily available sources of nitrogen to cotton is within about two weeks after chopping, as indicated by four years' results secured at Clemson College. One hundred pounds of nitrate of soda applied at chopping gave an increase of 53 pounds of seed cotton per acre, while the same amount applied two weeks later resulted in an increased yield of 107 pounds of seed cotton per acre. Delaying the time of application for two more weeks resulted in a slightly lower yield, in this case the increase being only 61 pounds seed cotton per acre over the yield where no side dressing was made.

Effect of Fertilizer on Cotton Fiber.—While many experiments have been conducted to determine the best fertilization of cotton for economical production, practically no attention has been devoted previously to the study of the effect of fertilizer treatment upon the cotton fiber and its spinning quality. Samples were taken from the series of plots in the Marlboro County experiment in 1926, upon which the Cotton Spinning Research Laboratory of the U. S. Department of Agriculture which is located at Clemson College, conducted manufacturing tests. Each lot of cotton was carried through all marketing processes, and spun into yarn upon which additional tests were made. Although only one year's data are available as yet, some very interesting observations are possible. Mr. H. H. Willis, Senior Cotton Technologist who is in charge of this work, has recently prepared a preliminary report for publication.

Placement of Fertilizer for Cotton.—The proper placement of fertilizer in reference to where the seed are planted is often of as

much importance as the amount and quality applied. Frequently harmful effects caused by placing the seed in too close proximity to the fertilizer are noted and again the seed and the fertilizer may be too far separated for most efficient results. The type of soil, amount of fertilizer, distribution of rainfall, and possibly other factors as well, have a bearing on this point. Studies in both the Coastal Plains and the Piedmont have been continued this year. In addition, pot tests are being conducted in order to determine more accurately the effect upon germination of placing the fertilizer in various positions in reference to the seed.

In general it may be said that the nearer the fertilizer may be placed to the seed without any impairment of germination, the more efficient it is in increasing the yield of cotton. Similar results have been secured in both the field and the pot tests.

It might be noted that quite often a placement which will cause a slight injury to the stand will often give a better final yield. Placing the fertilizer in bands on either side of, and at the same level as, the seed appears to be the most satisfactory from the standpoint of both germination and final yield.

Ratio of Organic-Inorganic Nitrogen.—In cooperation with several other Southern stations an investigation is being conducted to determine the minimum portion of nitrogen which may be derived from organic forms in a complete fertilizer. Each experiment consists of a series of plots in which the nitrogenous fertilizer is derived from a combination of organic and inorganic sources, ranging from all inorganic to all organic.

Cottonseed meal is used as the organic source, and nitrate of soda, sulphate of ammonia, and leunaspeter are each used separately to supply the inorganic form of nitrogen. Two such experiments are conducted in the Piedmont section and results will be correlated with those secured by the other cooperating stations.

As this is the first year, no yield results are available yet, but general observations indicate that a relatively small proportion of the ammonia is required from organic sources.

Biological and Chemical Studies.—In order to correlate certain phases of our field fertilizer experimentation, 78 permanent plots, each one-four-hundredths of an acre in area, were constructed at Clemson College in 1927. The soil is typical Cecil sandy loam of average fertility. In the construction of the plots the surface soil was removed, concrete retaining walls constructed to a depth of 20 inches, and the soil thoroughly mixed before being replaced. The fertilizer treatments are for the particular purpose of studying nitrogen availability. While we have quite a bit of information as to the results secured from the use of the several sources in the field, we need to learn more of the chemical and biological changes taking place in the soil after various fertilizer treatments are made. It

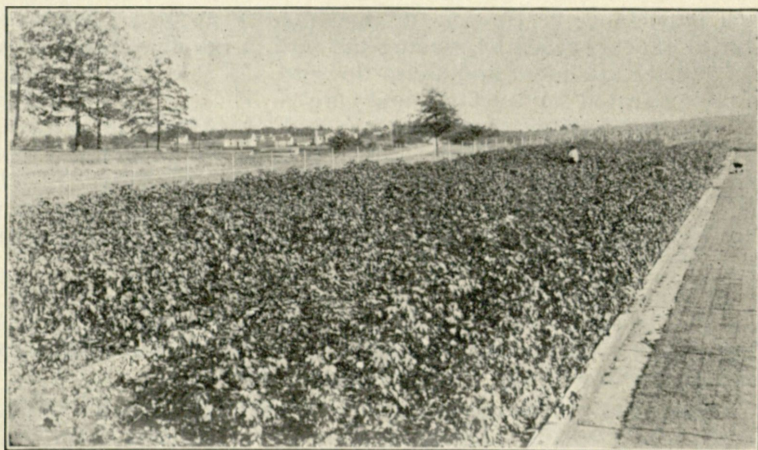


Fig. 8.—Cotton growing in permanent plots for biological and chemical studies at Clemson College.

was with a view of studying these factors that this work was undertaken. Yield data are also to be secured, but are not available as yet. Many interesting observations have been made from the chemical and bacteriological determinations.

The rate of nitrification of the various sources of ammonia, applied singly and in different combinations, has been studied throughout the growing season. The different materials showed considerable range in rate of nitrification, especially for the first few weeks after application. After the middle of August practically no nitrates were found on any plots, indicating that they were utilized by the growing plants as rapidly as formed. One plot received a quantity of rye straw, and here nitrification was very much delayed, indicating that the nitrogen made available from the soil was utilized by the bacteria in effecting decomposition of the mature rye straw. The cotton plants grown on this plot showed the effect of nitrogen starvation early in the season.

Determinations of ammonia (as such) were made at intervals. In no case was the merest trace of actual ammonia found in the soil the middle of July or later. Thus it is seen that even where ammonium salts were applied, they were changed into other forms, and did not long remain in the soil as ammonium compounds.

One series of the plots had lime applied at the rate of approximately one ton of ground limestone per acre. This was sufficient to make the soil reaction about 6.3 pH, which is believed to be approximately the optimum reaction for cotton.

Determinations of the soluble phosphorus were made at in-

tervals throughout the growing season. The amount of soluble phosphorus was found to be considerably higher on the limed plots than where no lime had been applied. This is in accordance with results secured by other workers on the same problem.

Unlike the nitrate, the soluble phosphorus content of the soil remained remarkably constant throughout the growing season, indicating that as the soluble phosphorus was utilized by the growing plant, conditions were such that an additional supply from the soil reserve went into solution.

The soil temperature is a very important factor in the growth of the cotton plant, especially early in the season. In the permanent plots mentioned above, accurate records of the soil temperature have been taken several times daily throughout the entire season as well as a continuous record on one plot. The maximum soil temperature during the months of June and July was found to occur about 7:30 P. M. The average daily range of soil temperature was about 3.6 degrees F., indicating that at a depth of only a few inches the soil temperature is fairly constant. It was observed that the cotton made very poor growth until the soil temperature rose above 70 degrees F.

MISCELLANEOUS COTTON EXPERIMENTS

Seed Treatment Test.—The seed treatment test was continued in 1927 to determine the effect upon yield of various treatments made to the seed before planting. As was the case in previous years, delinting the seed with sulphuric acid resulted in the highest total yield, 1403 pounds of seed cotton per acre. The next highest yield, 1315 pounds, was secured from machine-delinted seed, and normal seed without treatment produced but 1243 pounds of seed cotton per acre. Rolling in soda continued to give unsatisfactory returns, the yield being 58 pounds per acre less than where no treatment was given the seed. Apparently germination and early growth suffer ill effects from the close contact with the soluble salt.

Time-of-Planting Test.—The time of planting cotton is of extreme importance under boll weevil conditions, for the earlier plantings have the opportunity to set much fruit prior to the period of greatest damage by the boll weevil. The following figures show how time of planting influences yield.

Date Planted	Yield
March 21	2120
April 1	1980
April 15	2040
May 1	1900
May 15	1120

It will be noted that the highest yield was secured from the

earliest planting. There was but very little difference in the yield for the plantings made between March 21 and April 15. Plantings made after the middle of April produced considerably lower yields, however, and this was especially true of the May 15 planting. This confirms our general recommendation, which is that in normal seasons all cotton in the upper part of the State should be planted by about April 20 if highest yields are to be secured.

Cotton Spacing Test.—Results from the cotton spacing test were very much like those secured in former years. The highest yield was produced by close spacing. Eight-inch spacing of single plants gave a yield of 1439 pounds of seed cotton per acre, followed by 1313 for unthinned, 1280 and 1032 for 16-inch and 24-inch spacing respectively.

Cotton Variety Studies.—The leading strains and varieties of cotton are included in the variety tests conducted at Clemson College and the three substations. While the yield data are of most importance, attention is also paid to many other factors, especially quality of lint. Inasmuch as the present demand of the textile industry is largely for cotton of one inch staple, no variety which will not produce approximately this length of staple under normal conditions is considered as being well adapted to South Carolina conditions.

The average yields at Clemson College for the past four years show that King, Cook 1010, Cleveland Coker 5, Bottoms, and Cook 588-219 led with a yield ranging from 879 to 848 pounds of seed cotton per acre. Of these, only the strain of Cleveland has produced a staple of as much as one inch in length. In fact, all of the other varieties have often failed to produce even 7-8 staple, the minimum length tenderable on future contracts.

A test of the spinning quality of a number of the best adapted varieties has been conducted in cooperation with the Textile Testing Laboratory of the United States Department of Agriculture maintained at Clemson College. Lint of each of the several varieties is furnished for manufacturing tests to determine its value.

The study of the fruiting characteristics of a number of varieties has been continued, although along slightly modified lines. In previous work distinct plant differences as to shedding percentage and length of bud and boll periods had been noted. It was thought desirable to determine whether or not this is an inherited character, and if so what are the possibilities of developing strains which represent the extremes. Accordingly, selfed seed from individual plants which had exhibited striking differences as to shedding percentage and length of boll period in 1927, were planted.

Corn Production Investigations

Although corn is grown on practically every farm in South Carolina, only secondary consideration is given the crop. As a re-

sult the average yield in recent years has been only about fifteen bushels per acre. During the same period the average yield for the United States at large has been approximately twenty-eight bushels per acre. The experiences of numerous farmers in all sections of the State demonstrate clearly that this low average is not due to soil and climatic conditions, but to poor cultural and fertility practices. Such demonstrations clearly point to the possibility of raising the average State yield per acre to a point of profitable production and at the same time satisfying the requirements of home consumption. The acreage of corn in South Carolina does not need to be increased—at least, not under present conditions—but a larger yield per acre is very necessary if economy of production is to be maintained.

Variety Tests.—Much of the corn planted in South Carolina does not belong to any variety but is corn which has been handed down from year to year, often with very little, if any, selection practiced.

The Experiment Station recognizes the opportunity of serving the farmers by determining which varieties will produce highest yields. Experiments have been continued to determine the best adapted variety or varieties, the tests being conducted at Clemson College and each of the three substations. Of the varieties tested at Clemson College during the past five years; Paymaster, Douthit's, Goodman's Prolific, and Hastings' Prolific led in the order named. The four leading varieties tested at the Pee Dee Station during the past seven years were Pee Dee No. 5, Coker's Garrick, Douthit's, and Brunson. The varieties producing the highest yield in the test conducted at the Coast Station were Hastings' Prolific, Douthit's, Goodman's Prolific, and Weekley's Prolific.

Much interest has been evidenced recently in the development of a well adapted and high yielding yellow variety. Work along this line was undertaken in the spring of 1928, and seed of all yellow varieties which showed any possibility of being adapted to local conditions were planted at Clemson College for careful study as to yield and adaptability to South Carolina conditions.

Fertilizer Experiments.—In the fertilizer experiments with corn, the influence of the plant food elements in a complete fertilizer has been determined by varying each element, in turn, from nothing to what was thought to be the maximum quantity the plants could utilize. Such experiments have been conducted in a number of counties.

Where either phosphoric acid or potash was the varying constituent, but very little difference in the yield was noted, as the production of corn was in almost direct relation to the amount of nitrogen applied. A rather liberal application of this element practically doubled the yield.

This does not necessarily mean that corn does not require some

phosphorus and potassium, but it does indicate that where these elements have been applied to previous crops, but little response is to be expected from their application to corn.

Small Grains

Small grains occupy an important place in our agriculture and interest in their production is increasing from year to year. This is especially true in the case of barley and oats. Barley is now recognized by many farmers as being a satisfactory substitute for corn as a feed for work stock and is gaining favor as a hog and cattle feed.

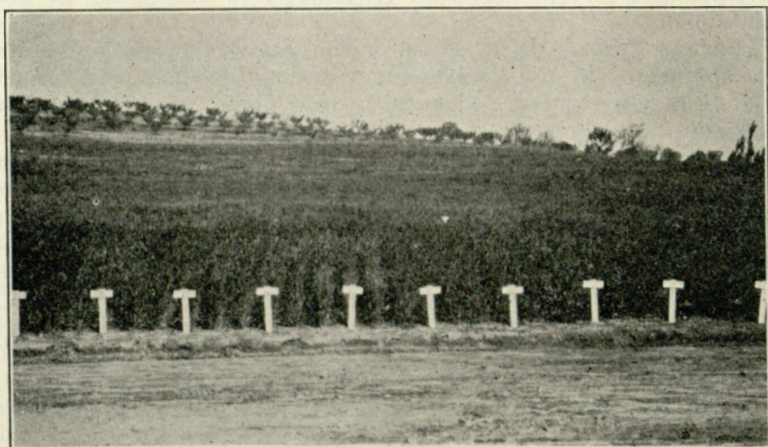


Fig. 9.—Small grain experimental plots, Clemson College, 1928.

Oats.—The severe weather prevailing in January, 1928, afforded a splendid opportunity to test out the winter hardiness of the varieties planted. Only Norton and two varieties the seed of which were secured from Virginia, survived the severe winter of 1927-28. These were not damaged at all and produced excellent yields. It appears that greater attention should be paid to winter hardiness in oats.

Experiments to determine the most efficient methods of fertilization as to analysis and the time and rate of application have been continued. These experiments indicate that where oats follow cotton in a rotation only a light application of complete fertilizer is needed at planting, supplemented by a relatively heavy application of readily available nitrogen early in the spring. The yield of oats has been found to be in almost direct relation to the amount of available nitrogen applied at this time. The results from five experiments conducted in 1928 are given below:

Top Dressing	Bushels per Acre
None	26.9
100 pounds nitrate of soda	43.2
200 " " " "	57.1
300 " " " "	70.0
No phosphorus or potash	21.4

All plots except the last received 200 pounds of superphosphate and 50 pounds of muriate of potash per acre.

It will be noted from the figures presented above that where no fertilizer at all was applied, the yield was very low—only 21.4 bushels of oats per acre. Where 200 pounds of superphosphate and 50 pounds of muriate of potash was applied at planting, the yield was increased only 5.5 bushels. The addition of 100 pounds of nitrate of soda on March 1 had the effect of increasing the yield 16.3 bushels, while the two additional increments of 100 pounds of nitrate of soda each increased the yield 13.9 and 12.9 bushels per acre respectively.

The following figures are presented to show the results secured in four trials in 1927 and 1928 from the use of various nitrogenous materials applied as topdressing to oats early in the spring at the rate of 27 pounds of ammonia (150 pounds of nitrate of soda or equivalent) per acre.

Source of Nitrogen	Bushels per Acre
Nitrate of Soda	36.8
Calcium Nitrate	34.8
Nitrate of Potash	34.1
Leunasalpeter	33.9
Sulphate of Ammonia	33.5
Ammo-Phos.	31.8
Urea	29.9
None	15.7

As will be noted, all materials which supplied nitrogen in the form of nitrate produced higher yields than those materials which supplied nitrogen in other forms. This was probably due to the fact that at the time the topdressing was applied the soil had not warmed up sufficiently to allow nitrification to proceed at a rapid rate.

Barley.—Work has been continued with the two selections of awnless barley developed by the Agronomy Division. These were very promising in the spring of 1928, but a severe hailstorm just prior to harvesting practically ruined all possibility of securing yield records. Breeding experiments are to be continued on an enlarged scale this season.

Wheat.—Although South Carolina will probably never be a

commercial wheat producing state, the crop is of considerable economic importance, especially from the standpoint of home production.

Rye.—Rye is planted largely as a grazing or cover crop, either alone or with a winter legume. Abruzzi is the only variety considered well adapted, although variety tests which include all strains or varieties possibly adapted to South Carolina conditions are conducted. The value of rye as a winter cover crop is also given considerable attention in the experimental work.

Winter Legumes

Austrian Winter Field Peas.—No other crop introduced into the State has so rapidly come into general favor as the Austrian winter field pea. Although first grown in an experimental way only about four or five years ago, it has now come to be regarded as the best adapted winter legume which can be grown for feed or soil improvement. Experimental results indicate that early seedings are decidedly preferable to seeding at a later date, and also that relatively heavy seeding give best results.

A comparison of the Austrian winter field pea with hairy vetch indicates that the former is more winter-hardy and will produce a higher yield early in the season. In a test at Clemson College last winter the Austrian pea produced a yield of 4870 pounds of dry matter per acre as compared with 4150 pounds for hairy vetch grown under similar conditions. Chemical analyses showed the percentage of nitrogen for the two crops to be Austrian winter field pea 4.38 and hairy vetch 4.14.

Further experimental work is under way to determine the best cultural practices for this crop.

Other Winter Legumes.—For several years small plots of all winter legumes which may possibly be adapted to local conditions have been planted at Clemson College. Information as to general adaptability, winter hardiness, rate of early season growth, final production, and nitrogen content is secured.

The effect upon the succeeding corn crop of turning under various winter legumes is also being studied. These plots have already been planted and an excellent stand secured early in October.

Soil Survey

The soil survey project is in cooperation with the Bureau of Soils of the United States Department of Agriculture. During the past season the survey of Williamsburg County has been completed, and work is next to be undertaken in a Piedmont county. There are at present about one-third of the counties of the State which have not been surveyed. It is hoped that surveys may be made of these counties within the next few years.

Plans are being perfected to make a reconnaissance survey of the counties which remain unsurveyed so that the State soil map may be completed immediately. This will not give the same detail that the county maps contain, but should be of much benefit to farmers, county agents, agricultural teachers, and all others interested in agricultural development of the State.

Cooperation with Other Stations

Very satisfactory progress has been made in the cooperative undertakings with the other Southern stations. Several definitely outlined experiments are now being conducted jointly by three or more stations. Such cooperation permits the solution of a problem much more rapidly than if only one station were working alone. Definite agreements have been reached on most of the larger problems undertaken so that where new experiments are outlined they follow the same general plan in all of the cooperating states. Conferences of the Agronomy Research Committee of the Southeastern States are held once or twice each year at which time progress on the several projects is noted and future policies and work discussed.

EXPERIMENTS WITH LIVESTOCK

Our experimental work with livestock this year has dealt with feeds, methods of feeding, and breeding. Each experiment is so designed as to have a practical bearing on the immediate development of the livestock industry in this State.

Considerable importance is attached to the problem of economical feeding of hogs. It is only by the liberal use of forage crops that this section can compete successfully with the middle west in the production of hogs for market. Previous tests have shown the superiority of the soybean as a forage for summer grazing and we are now working on some winter forage crops including barley, oats, rye, and Austrian winter field peas.

The farmers of South Carolina are making profitable use of our experimental data. In less than twelve months 678 demonstrators, using our recommendations, produced and marketed 91 carloads of hogs. These hogs brought to the farmers a total of \$101,703.48, or an average of \$148.04 per farmer.

The show record of our Berkshire herd proves beyond a doubt that Clemson College has the best herd of Berkshire hogs in the United States. This entire herd is being used in one form of experimental work or another; for example, in our feeding tests the life history of each animal is known in complete detail.

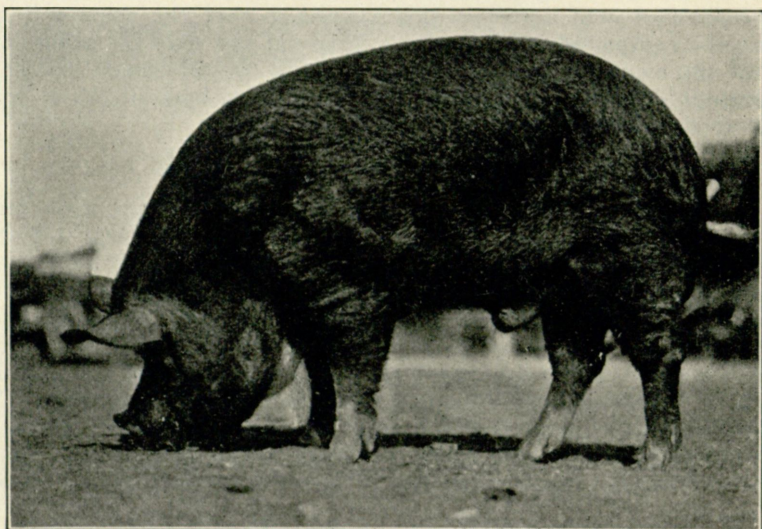


Fig. 10.—Grand Champion Boar, 1929.

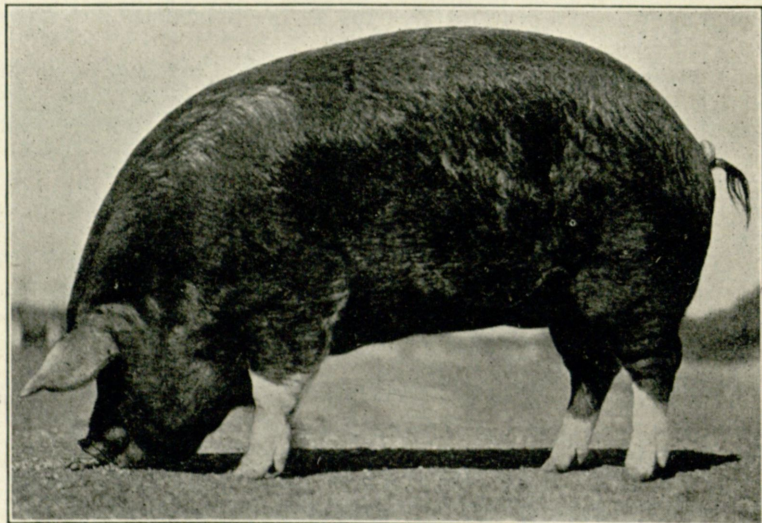


Fig. 11.—One of the sows in our Berkshire herd.

Protein Supplements for Fattening Hogs

Previous tests at this Station have shown that fish meal has produced more economical gains in combination with soybean meal or peanut meal than has tankage in the same combinations. The 1927-28 tests substantiated these previous ones and showed that for this year peanut meal (in combination with fish meal) gave more satisfactory results than soybean meal (in combination with fish meal). The hogs receiving fish meal and peanut meal supplements made average daily gains of 1.75 pounds per hog per day at a cost of seven and one half cents per pound, while those receiving soybean meal with fish meal gained on the average of 1.59 pounds per day at a cost of eight cents per pound.

An additional test of this kind was conducted at the Pee Dee Station comparing soybeans grown in corn (and hogged down) with tankage fed as a supplement to standing corn alone. The hogs on corn and soybeans produced the cheapest gains (\$4.34 per 100 pounds as compared with \$6.03), but those on standing corn and tankage made the fastest gains (1.87 pounds per day as compared with 1.34 pounds). Corn and beans grown in adjacent lots produced the slowest and most expensive gains.

Grain Rations for Hogs on Soybean Forage

Soybeans have proven one of the best forages for general use in fattening hogs in the Southern States. There is still some question as to the proper grain that should be used as a supplement. The 1927 test was conducted to compare rations of corn alone and of corn and tankage fed in limited and full amounts to hogs grazing soybeans. Green beans were grazed from June 29 to August 24. Mature beans were used during the remainder of the fattening period.

Through the green bean grazing period the hogs receiving a full feed of corn and tankage made the most rapid and the most economical gains.

Through the entire test full-feeding corn and tankage produced the most rapid gains while limited-feeding corn produced the most economical gains. However, the fact that the full-fed lots were ready for an earlier and higher market tended to make this method of feeding more profitable.

The average feed saving value of an acre of green beans was \$39.28 while only \$22.85 was saved by an acre of mature beans.

The Effect of Inbreeding on the Growth of Pigs

The remarkable record made by our Berkshire herd has suggested a careful study of the effects of inbreeding (brother and sister matings) on the off-spring. In this experiment we are also

using our herd of Poland Chinas. Sufficient litters have not been produced since this test was begun to give the information sought. All off-spring are weighed and measured at birth and every seven days until weaning at eight weeks of age. Six measurements are taken,—height, length, spring of ribs, heart girth, depth of heart, and size of bone.

Steer Feeding

This Station is cooperating with the United States Department of Agriculture and other experiment stations in studying some of the factors affecting the tenderness and palatability of meats. Breeding is a factor that has been thought to have a marked influence on the quality of meat produced. During 1927-28 a test was conducted comparing native scrub steers with purebred Herefords when fed on shelled corn, cottonseed meal, and corn silage. The purebred steers made an average daily gain of 2.59 pounds as compared with 1.89 pounds for the scrubs. However, the feed cost per 100 pounds of gain was slightly in favor of the scrubs. The higher finish and higher selling value of the purebreds made them decidedly the more profitable lot. At the close of the feeding test the steers were shipped to Beltsville, where palatability and tenderness tests were made. The results of these tests will be published later.

RESEARCH WORK IN CHEMISTRY

The Division of Chemistry is engaged in two major projects and is cooperating with five other divisions of the Experiment Station in carrying out the chemical phases of their particular projects.

Chemical elements, and particularly minerals, play an important part in the development and growth of plants and animals. In spite of their importance, however, little is known of the mineral content of feeds grown in the South, and less is understood about its relation to the mineral content of the soil. A lack of proper minerals results in malnutrition, depraved appetite, breeding troubles, and many common ailments and afflictions.

In a project designed to shed light on this important subject there were analyzed during 1927-28 a total of 452 samples of feeds and soils. Seven determinations were made of each sample, there being determined the moisture, ash, iron, calcium, magnesium, phosphorus, and iodine content in each case.

Certain very marked tendencies have been observed. For example, clovers, alfalfa, and soybeans have been noticeably high in calcium, while phosphorus was more in evidence in samples of crab grass and cowpea hay, and magnesium was found more abundant in grass hay and soybeans.

There is not sufficient evidence to say that there is any definite relation between the mineral matter in the soil and that of the plant.

It does seem possible, however, to increase the phosphorus and calcium content of plants by the addition of these elements to the soil in the form of fertilizer.

Because of the unusual interest which has been attached to the element iodine in foods and feedstuffs grown in South Carolina, that part of the study of mineral content of feeds and soils dealing with this element has been enlarged and studied as a separate project. To the results already secured in the study just described, there have been added data obtained from analyzing drinking waters, river waters, water from small streams, springs, and wells, together with figures on the iodine content of many samples of different kinds of vegetables.

The results of all of these investigations and analyses have been summarized for publication in bulletin form but a general summary will be of interest here.

In the analyses of soils it was found that less iodine was present in the first six inches than in the second six and that the amount present increases with depth through eighteen inches. This may be due to a combination of causes. It has been proven that there is an evaporation of iodine from the soil, plants remove some (principally from the first twelve inches) and leaching by water carries some downward. More iodine is found in the soils from the upper part of the State than in those around State Park and Florence. This is probably due to difference in the rocks from which the soils were formed.

The iodine content of plants draws considerable variation within the same variety. Only by analyses of a great many samples of numerous kinds of plants will it be possible to draw definite conclusions as to the preference of either for this element. In the examination of feeds vetch, alfalfa, Austrian winter field peas, soybeans, and oats showed higher iodine content than did any of the other feeds analyzed. Of the vegetables analyzed spinach, mustard, lettuce, and sweet potatoes showed greater amounts of iodine than did other vegetables.

In the analysis of city waters two samples were obtained, one of raw water and the other of purified water, the purpose being to determine the effect, if any, of the purification process. In every case there was a loss of iodine in purifying the water for drinking purposes. This loss varied from thirty to seventy percent. Raw water from Columbia, Charleston, Spartanburg, and Greenville showed iodine to the extent of from 4.16 to 5.42 parts per billion, while purified waters from these same cities analyzed from 1.41 to 3.16 parts per billion. Iodine loss from purification seems to have been greatest in Spartanburg and least in Greenville.

Waters from eight of the rivers in the State were analyzed and it was found that the amount of iodine varied from two to six parts

per billion in the different rivers, the largest amounts being found in the Enoree and Broad. There is of course a rather definite relation between the iodine content of waters from creeks and rivers and that of city drinking water taken from the particular stream.

EXPERIMENTS WITH DAIRY CATTLE

Research work of the Dairy Division as in the past few years has dealt largely with methods of breeding and feeding dairy animals. With two of the feeding problems three years' work have now been completed and it is planned to publish in bulletin form at an early date a complete summary of this work.

One new project has been added to the list of research problems. A study, in cooperation with the Bureau of Dairy Industry at Washington, is being made of the relation between the external form and internal anatomy of the dairy cow and her producing ability. This is necessarily a long-time project as much data must be assembled before a definite correlation can be computed.

Corn Versus Sorghum Silage for Milk Production

The winter of 1927-1928 marked the completion of three years' work on the study of the comparative values of corn and sorghum silage as feeds for milk production. Ten cows, divided into two lots of five animals each, were fed rations similar to those used in the trials of 1925-26 and 1926-27.

In connection with the work of the past winter a digestion



Fig. 12.—Lot 1. Animals used in corn versus sorghum silage feeding trial, 1927-28. Photograph taken at close of experiment.



Fig. 13.—Lot 2. Animals used in corn versus sorghum silage feeding trial, 1927-28. Photograph taken at close of experiment.

trial was conducted with two animals over a period of 15 days to determine the percentage digestibility of the constituents of sorghum silage. Henry and Morrison use digestibility coefficient for Japanese cane silage that is computed from "similar feeds," which indicates that there is a need for further inquiry into this point. When the chemical analyses have been finished it is planned to publish in bulletin form a complete study of the results of the three feeding trials with corn and sorghum silage, together with a report of the digestibility of the constituents of sorghum silage.

The Utilization of Sorghum Grains in Silage

In the Station report for the year ended June 30, 1927, mention was made of a study of the amounts of corn and sorghum grains from silage passing through the digestive tract of dairy animals. This work was repeated this year with the sorghum only. It was felt that the amount of corn grains lost into the feces was so small as to be practically negligent. A duplicate check on the results with the sorghum grains was desired.

Two cows were fed a ration consisting of sorghum silage and a grain mixture of equal parts of finely ground yellow corn meal and cottonseed meal. Over an actual collection period of 10 days the feces were weighed daily and 10-pound samples taken from each cow. These samples were washed, sieved, and dried and all portions of the sorghum grains remaining on a No. 20 mesh screen saved and weighed.

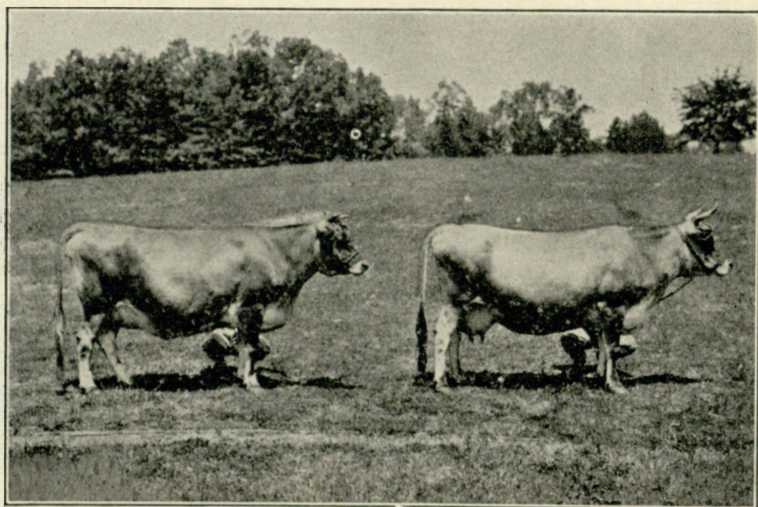


Fig. 14.—Animals used in digestion trial of sorghum silage, 1928.
Photograph taken at close of experiment.

A determination of the grain content of the original silage was obtained by weighing the amount of seed in fifteen 1-pound samples of silage.

By a comparison of the amounts of seed consumed and that voided in the feces it was found that the two animals lost into the manure 28.28 percent and 26.30 percent respectively of the amounts of seed fed.

The Value of Grinding Hay for Dairy Cattle

Oats and vetch hay was used in a feeding trial during the past winter in an experiment, continuing the work which this Division is doing, to compare, as feeds for dairy cattle, ground and unground hays. The experiment was conducted as previously over a period of 120 days with two lots of cows consisting of five animals each. The comparative rations, composed of oats and vetch hay, corn silage and a grain mixture differed only in the physical condition of the hay when fed.

The following results were obtained during the 1927-28 trial:

1. The palatability of the hay was increased slightly by grinding, as evidenced by the difference in the quantities of hay refused with the two rations. During the experimental feeding period 10.79 percent of the unground hay fed was refused, as compared with a refusal of 4.14 percent of the ground hay.
2. The average daily production per cow on the unground hay

ration was 21.05 pounds of milk testing 4.56 percent butterfat. The average daily production per cow on the ground hay ration was 21.08 pounds of milk testing 4.58 percent butterfat.

3. To produce 100 pounds of milk the following feeds were consumed:

Type of ration	Hay Lbs.	Silage Lbs.	Grain Lbs.
Unground hay -----	36.88	138.98	39.16
Ground hay -----	44.96	138.86	35.19

The ground hay was ground in a hammer type mill, using an eleventh-sixteenths-inch mesh screen.

This particular phase of the hay grinding work is completed with the past season's trial. Data are now accumulated of similar trials with alfalfa and soybean hay and will be published in a proposed bulletin at an early date.

The Digestibility of Ground and Unground Oats and Vetch Hay

Four dry mature cows were used in a digestion trial,—two receiving ground hay and two unground hay. The following results, based on an actual digestion period of fifteen days preceded by a ten-day preliminary period, were obtained:

Coefficients of Digestibility of Unground and Ground Oats and and Vetch Hay

Type of hay	Dry matter	Ash	Protein	Crude fiber	Nit-free extract	Ether extract
Unground	63.873	42.043	88.338	63.332	62.718	71.858
Ground	61.753	32.568	86.072	60.812	61.350	74.883

It is noted that the difference in digestibility of the two types of hay is very small in every case. In all instances with the exception of the ether extract there is, however, a slight decrease in the coefficient of digestibility of the ground hay. The results are fairly conclusive that the digestibility of oats and vetch hay is not increased by grinding.

A Study of the Normal Growth of Dairy Heifers as Determined by Weights and Measurements

This project is a continuation of the work begun in February, 1926, to determine the growth of dairy animals, as kept under normal conditions at the Experiment Station, by a systematic schedule of weights and measurements taken at monthly intervals. The study has not been in progress a sufficient length of time to permit definite summary results, but the accumulating data is proving a valuable source of information for many of the problems associated with the raising and growth of dairy animals.

Photographic Studies of Growth and Development of Dairy Animals

The Dairy Division is cooperating with the United States Bureau of Dairy Industry in a systematic study of the growth and development of dairy animals as depicted by actual photographs. This work is being carried on with Holstein animals only and serves as an additional source of study to that previously mentioned of the different systems of mating dairy animals.

To date 325 photographs have been taken. The accumulation of pictures from this and other cooperating stations will ultimately be assembled for study and should provide an invaluable source of data for the study of some of the factors which affect body growth and conformation.

Advanced Registry Testing

At the present time there are 125 purebred cows on Advance Registry Test in this State. This number has remained practically constant for the past year. New records are being started as old ones are being completed, and this keeps the work rotating.

Two testers have been employed for practically full time during the year to carry on this work. These men visit the farms of the breeders once each month to weigh and test the milk of the cows on official test for one or two days with a preliminary milking, depending upon the breed being tested. These records are sent to the Clemson College office of the Dairy Division, South Carolina Experiment Station, for checking and certification.

There were some creditable records completed during 1927-28. The most outstanding one was 22,834.6 pounds of milk and 792.2 pounds of butterfat made by the Holstein cow, O. K. L. Katie Paul, owned by Mr. V. M. Montgomery, Spartanburg, S. C.

Of the 90 records completed during the year, 46 were Guernseys, 27 Holsteins, and 17 Jerseys.

The 46 Guernsey records averaged 522.9 pounds of butterfat, an increase of 12.1 pounds over the previous year's average. The Holsteins averaged 481.6 pounds of butterfat, a slight decrease from the previous year's average. The 17 Jersey records averaged 574.6 pounds of butterfat, an increase of 22.5 pounds over the previous year's average. The records, 90 in number, on all breeds averaged 520.3.

In the Experiment Station herd at Clemson College, approximately 20 cows are on official test at all times. The present policy is to place all cows on test with their first calf and if the opportunity permits, to allow them to make a second record at a mature age.

Slaughter Work

The judging of dairy cattle at our fairs and expositions is done by experienced breeders who by observation and the study of the

various breed score cards have formed opinions as to what is required in the form of a dairy cow to indicate producing ability and breed type. Since such an important phase of dairy development is left to conjecture, there is often much complaint and misunderstanding as to the correct placing of animals. However, this system is the best available at the present time because there are no definite facts on which to judge dairy cattle. Therefore, this project is outlined to determine the relations of the different parts of the cow's body to her production record. The old cows, or cows that have damaged udders or for other reasons have become unprofitable to maintain in the Experiment Station herd, are first subjected to a complete set of external body measurements and observations, then these cows are slaughtered and complete post-mortem data are secured for the weight and measurements of the vital organs and internal body capacity.

All the cows used for this project have completed yearly production records under similar conditions, so the results secured are comparable and may be used to make correlations.

To date seven complete ante-mortem and post-mortem records have been made. These few records do not permit conclusions, but have brought out some interesting comparisons.

One Holstein heifer with a record of 410.94 pounds of butterfat had a total length of intestines both small and large of 182.414 feet; while another Holstein heifer with a record of 439.90 pounds of butterfat had a total length of intestines of 159.448. A mature Guernsey cow with a record of 633.1 pounds of butterfat had a total intestinal length of 210.465 feet. There are other interesting comparisons that could be made, but with the available data they are not significant.

This project is being conducted in cooperation with the U. S. Bureau of Dairy Industry and some eleven other state experiment stations, so the volume of data will accumulate rather rapidly from year to year.

STUDIES OF INSECT PESTS

Insect pests constitute one of the principal hazards in crop production. The presence or absence of a particular insect pest often makes the difference between success or failure in producing a profitable crop. The workers in this field are striving to improve and simplify the methods of controlling troublesome pests and to develop satisfactory practices for preventing injury by new pests which are assuming dangerous proportions in agriculture.

Our observations and correspondence indicate that an unusual number of kinds of insects did noticeable damage during the year, the following appearing to be worse than in the average of past years:

Corn billbugs	Boll worm
Mole crickets	Southern corn-stalk borer
Mexican bean beetle	Red spider, on cotton
Harlequin bug	Fall army worm (or related sp.)
Cutworms	Stinging caterpillars (several kinds)
Boll weevil	

The destructive abundance of red spider on cotton was a surprise as it is generally considered to be a dry-weather pest,—if so it quickly took advantage of the short dry intervals in several counties in the central and eastern sections of the State, where it did noticeable damage over a short period.

The harlequin bug was apparently greatly reduced in number in the Piedmont section (at Clemson College, for example) during the winter of 1927-28, presumably by the unusually severe freezes in January. In the spring it was very scarce at Clemson but during the summer it recovered its numbers to large extent, and the complaints of it from over the State at large seemed more numerous than in the average of former years.

During late summer there were complaints of an insect which many believed to be fall army worm and which quickly became known by that name. It was several times reported from cotton, sometimes with the statement that it first defoliated the poke-weeds. In a garden we saw them devouring the foliage of sweet potato, pepper, tomato, and okra, while along a roadside we saw them attacking goldenrod, giant ragweed, cocklebur, and smartweed. As the season was late, the monetary loss was not severe in most cases, and where poisons were promptly applied on the first appearance of the worms, effective control was usually secured. As the worms became grown, we found that large numbers were killed by beneficial insect parasites.

Several species of caterpillars which have the power of inflicting painful stings, were reported from various parts of the State. The saddle-back caterpillar and flannelmoth caterpillar figured in these complaints and the caterpillars of several related species were common at Clemson College in late summer and early fall.

Two New Pests Located

During the year two insect pests were found within the State whose presence had not before been positively recorded.

On July 19 peach twigs infested with the larvae (caterpillars) of the Oriental moth were received from Florence County. This insect is regarded seriously in the North, but appears to be much less serious in our Southern States because we do not grow the very late varieties of peaches in the fruits of which the late season generations of the insect develop. Peach twigs had before been found which showed injury "typical" of this insect, but in the present case the

living larvae (caterpillars) were present in the young twigs, and the exact identification was made at the Peach Insect Laboratory of the U. S. Bureau of Entomology at Fort Valley, Ga. The spraying practices already in use in our commercial peach orchards, together with the fact that we have few peaches later than Elberta, are apparently sufficient to prevent this insect from becoming a serious pest. The same is true in the adjoining states where its presence has been known for several years.

On July 16 specimens of what has been called the "new cotton beetle" (*Luperodes varicornis*, Lec.) were sent from McCormick County, where they were damaging blooms and squares of cotton. It is a small, dark brown, nervously-active and frail member of the "leaf-beetle" family, and devours the young leaves, petals, and bracts of the squares of cotton, also silks of corn. It was recorded from both Georgia and North Carolina some years ago, and has probably long been present in this State but had not been recorded. It usually appears suddenly in great numbers, does minor or mild damage for a short time, and then quickly disappears.

Corn Bill Bugs

Studies of the billbugs which damage corn in the eastern section of the State have been continued as one of our approved projects, at the temporary field station in Lee County.

The particular species (*C. maidis*) at which these studies are especially aimed, has been quite thoroughly studied with reference to its life history, habits, and economy. It has been found in Lee, Sumter, Darlington, Marlboro, Chesterfield, and Kershaw Counties. During this year the average number of eggs laid by the females in cages was 44, while ones confined in small tin boxes laid a smaller number. The largest number laid by one female was 164 eggs. The maximum rate of egg-laying observed was 7 eggs laid by one female in 24 hours. It was ascertained that this species does fly—a fact not positively known before, although its chief method of invading a field appears to be by crawling, and observations were made upon the rapidity of this.

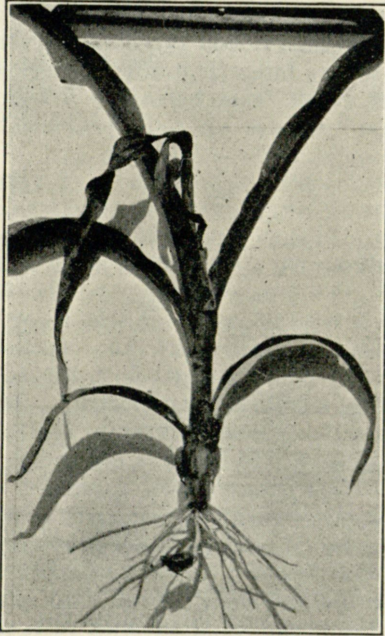


Fig. 15.—Young corn stalk showing bill bugs at work at base and on roots.

This destructive billbug is hardy, and during the year some tests were conducted bearing on this point. In tests with calcium cyanide (which generates a strongly poisonous gas) a strength which killed house flies in three seconds and June bugs in two minutes, required 45 minutes to kill the billbugs. In another test several billbugs were submerged in water for 72 hours, after which every one of them revived—which test is enlightening in view of the fact that much of the lowlands in the eastern section of the State was overflowed this year. A certain species of wasp was observed to attack this species of billbug, but is apparently not efficient as a natural enemy.

Incidentally, other species of billbugs have been recorded from a number of the eastern counties, including Clarendon, Florence, Hampton, Lee, Marlboro, Orangeburg, and Richland.

Observations were also made at this field station in Lee County on the Southern corn stalk borer. This insect does damage to corn throughout the State but is apparently most abundant in the eastern section. The life history of the insect is being studied with the hope of gaining information which will aid in improving the control measures.



Fig. 16.—Poor stand of corn as result of damage by bill bugs, Lee County.

The Cotton Flea Hopper

The activities of the cotton flea hopper were somewhat less during 1928 than during 1927 and much less than during 1926. The destructive activities were limited to local areas where large infestations developed in late August and September. The infestation became such as to indicate the possibility of a cotton flea hopper year in 1929 unless weather conditions are unfavorable to the insect during the early part of the growing season of that year. The highest infestations found were in Anderson County, where late injury was very severe.

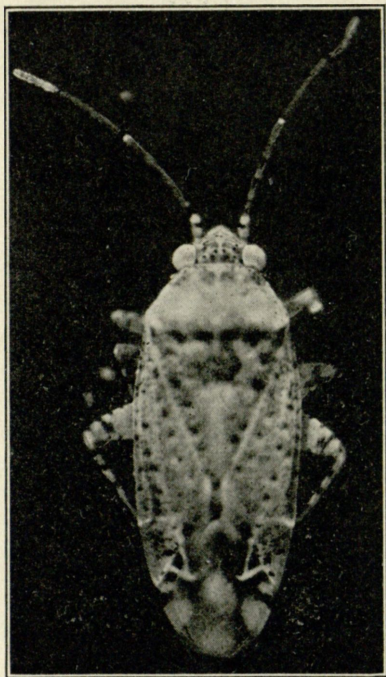


Fig. 17.—Adult of cotton flea hopper (greatly enlarged).

Activities of this insect during the past four years indicate that it is a potential pest that will assume a role of major importance in cotton production whenever the environmental resistance is not great enough to hold it in check. Present indications are that conditions favoring its activities will probably occur occasionally in the Piedmont section and less frequently in the Coastal section.

The cultural practices and poison methods which were found to be useful in combating the cotton flea hopper in 1926 were found effective in 1928. A full discussion of this problem is found in Bulletin 237 of this Station.

This work has been enlarged, and additional features of the problem have been worked out for publication in a bulletin now being prepared.

Thrips

It has been noted in previous reports of cotton insects that thrips were present on cotton during the time when seedling injury occurred. They were present on cotton again early during the season of 1928. They were present on cotton throughout the entire season, but later injury from them does not seem to be apparent.

Two species of thrips have been found commonly on cotton during the time when it has been studied to determine the cause of early injury. One of these species has been much more common than the other, and thus a few brief summary statements will be made about it. It has been commonly called the yellow thrip on cotton by the workers employed on the problem. The species, however, is a very common feeder and occurs in many flowers, and also on oats, wheat, peaches, apples, etc.

The adult thrip is a slender insect about 1-20 inch in length, varying from yellow to brownish yellow in color, and having two pairs of narrow wings margined with long hairs. The immature stages are wingless, and usually lighter in color than the adults.

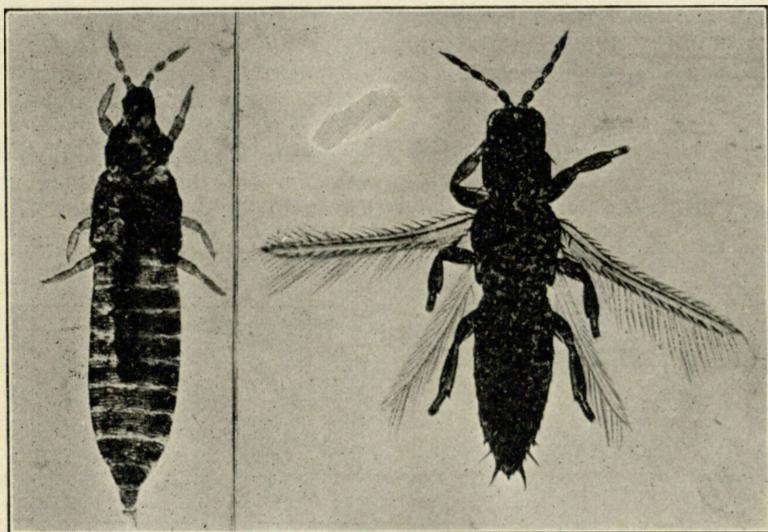


Fig 18.—Larva and adult of thrip (greatly enlarged).

The females deposit eggs in the leaf tissues by means of an ovipositor. After the eggs hatch the larvae escape from the leaves by a small hole. The larvae emerge head foremost from the leaf, the antennae proceeding in a sort of sheath. The immature stages undergo several molts and change before the adult stage is again reached.

Seven generations of the yellow thrips developed during the last season. The development periods vary from 14 to 22 days. The incubation periods have averaged from 5 to 6 days and the development periods of immature forms have averaged from 7 to 8 days.

Injury by the adult thrips is caused by their rasping away portions of the leaf surface and sucking the juices. They commonly feed in small depressions and protected places. Small round whitish spots are left in the tissues where they feed.

Good control of the thrips is secured by the use of nicotine sprays and nicotine oil emulsion.

The Mexican Bean Beetle

The Mexican bean beetle continues to be the most important pest among the insects destructive to truck and garden crops. Only the early spring and late fall crops of beans escaped serious damage or total destruction without the use of poison to control the pest.

The research work on the project concerned with this insect has consisted of biological studies, poison tests, and ecological investiga-

tions of an experimental nature. Much of the work is nearing completion but the data is not completed for final study nor analysis. Some discussion of a general nature is added. The results of the poison tests are reported briefly, as a part of the section, "Investigations with Insecticides".

Of the 4,000 beetles placed in hibernation cages in 1927 during the time they were migrating to hibernation quarters, 14.7 percent emerged and assumed normal activities during May and June. The

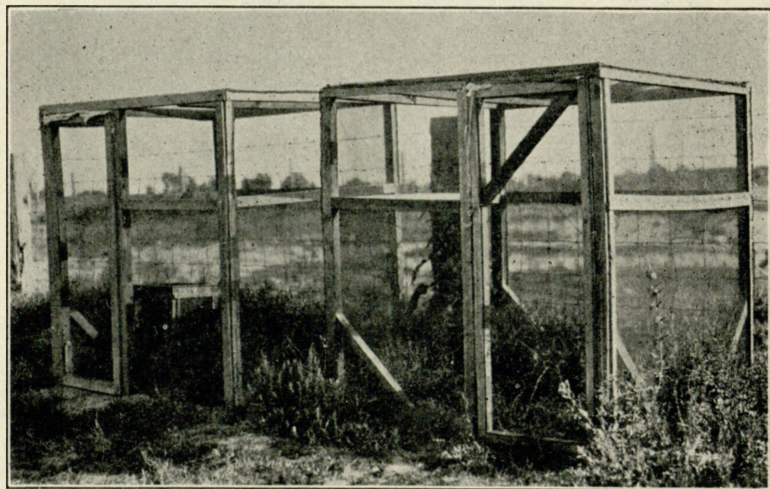


Fig. 19.—Cages for hibernation studies with insects.

emergence was very slightly lower than during the spring of 1927.

The first adults were found in the field on May 2. After this time the feeding of the adults gradually became more apparent. The first eggs were found on May 16 and larval injury became apparent during the last of that month. By June 1 destructive injury was apparent to the growers and poison control became necessary.

The succession of generations has been about the same as that reported for previous years except that all activities were delayed on account of a "late" spring.

The increase in distribution of the insect during 1928 is limited to a salient that projects into portions of Clarendon and Florence Counties.

One phase of the ecological studies undertaken is the measurement of the total resistance which the environment of this insect offers to its development. An effort is being made to evaluate the different environmental factors, both physical and biotic, with re-

spect to their relative importance in prohibiting the development of the potential numbers.

The Bean Leaf Beetle

The bean leaf beetle is one of the most important pests in South Carolina during certain years, particularly during periods of dry weather.

The chief hosts of the bean leaf beetle are garden beans, cowpeas, and soybeans. A large amount of injury is usually apparent on the early garden beans. The plants usually "outgrow" this injury, but sometimes poison control is necessary. During the late summer and fall, especially in dry years, the damage caused to cowpeas is enormous. The quantity of damage done during 1927 was so great that many growers did not plant cowpeas during 1928 since they feared another recurrence of the injurious activities of the previous year. Fortunately this did not occur. It may do so during any year when conditions are favorable for the development of the pest, but it is not deemed advisable to discontinue the planting of cowpeas because of this pest.

The Giant Root Borer

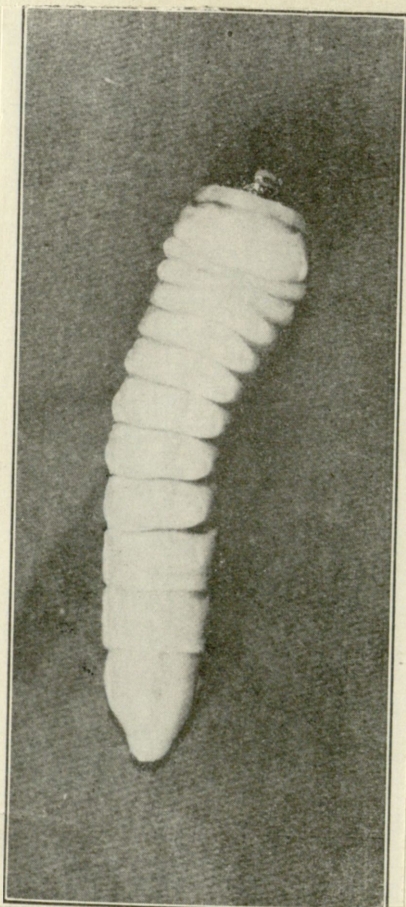


Fig. 20.—The giant root borer of apple (larval stage).

Preliminary research has been started on the giant root borer of apple. This borer is the larva of a large beetle belonging to the family *Cerambycidae*, a group of insects known especially for the destructive activity of the larva in trees. Very little is now known of this pest although it is known that approximately three years are required for the life cycle, which fact makes progress on the problem very slow. The insect is present in several orchards of the State and has caused a loss of about 75 trees in one of the large orchards in South Carolina. It tunnels its way into the live wood of the roots, usually in or near the crown, but occasionally following the roots several feet from the tree itself. These tunnels vary in size from very small to nearly two inches in diameter. Following this severe tunneling and girdling of the roots and crown the leaves turn yellow, the bark dries and wrinkles, and the tree dies.

Figure 20 illustrates a larva removed from the crown of a tree. The largest larvae found range from $2\frac{1}{2}$ to 3 inches in length.

Investigations in Insecticides

The excessive amount of rain during the year prevented the successful pursuit of any large amount of toxicity work. Many of the tests that were run could not be used in comparing toxicity values of insecticides because of rains, or very abnormal conditions which occurred. Poison injury to plants was excessive in the case of nearly all poisons, but this feature is not deemed significant, since a season like the last one occurs in this section very rarely.

One outstanding case of unexpected "burning" was that experienced from magnesium arsenate which heretofore has been one of the safest arsenicals to use on legumes in Mexican bean beetle control. Considerable "burning" was also experienced from lead arsenate in the control of the plum curculio.

Seven new materials were used in the poison tests in the control of the codling moth in apples. Nearly all of them caused excessive "burning" and the toxicity data is unreliable, because of the conditions mentioned above.

Crepe paper and corrugated paper bands treated with betanaphthol were unsuccessful in the control of the codling moth larvae. It is possible that this lack of control may have been correlated with excessive rains which washed the chemical out of the bands. The worms found ideal shelter for pupation in both types of bands. A slight darkening of the surface layers of the bark was noted also but indication of injury that might be cumulative was not apparent. The beta-naphthol bands might prove successful in dry years, but the experiments so far show that they can not be recommended. Growers are advised to continue the use of the burlap bands that are removed frequently to kill the larvae.

Much emphasis is being shifted from the study of hydrocyanic gas to arsenicals. Among the arsenicals used during the present season were aluminum arsenate, manganese arsenate, zinc arsenate, zinc arsenite, two types of magnesium arsenate, and many others. The study of the fluosilicates has been continued. Potassium fluosilicate is one of the new members of this group used this year.

Among the promising materials investigated this season are the Pyrethrum extracts. A number of companies are now manufacturing these materials and numerous states are experimenting in the growing of plants from which the Pyrethrum powder is derived. Nearly all of the trade brands differ widely in the amount of the toxicity element incorporated in their spray material. For that reason it is impossible to state any specific recommendations for the use of the material. The Pyrethrum extracts are new insecticides. They have been studied in a general way for a great many years, but it is only recently that improved methods of manufacturing the extracts have developed the possibilities of an effective insecticide. It must be realized that the results from such preliminary experiments are only tentative, but the experiments at Clemson College indicate that these products have great possibilities for use in insect control.

A special project has been in progress during the past summer to investigate the toxicity of calcium fluosilicate compound. Tests during 1927 with modifications of the commercial calcium fluosilicate compound indicated that the toxicity values of this product could be increased without causing any "burning" to tender foli-

age, such as bean leaves. The toxicity work was done with the Mexican bean beetle.

The cooperative research progress for the study of the calcium fluosilicate compound was arranged with the Victor Chemical Company. The Victor Chemical Company employed a college graduate, who had specialized in chemistry, and who had a working knowledge in entomology, to do the testing work at Clemson College. The South Carolina Experiment Station furnished the cages, plants, and other equipment. The method of making the study was the same as used in the other toxicity studies at Clemson College.

A series of about 566 poison tests with adult Mexican bean beetles gave results which showed that one of the best improved materials gave a control which was more than one-third greater than that of the original compound. In the tests with the larva of the Mexican bean beetle this improved compound had a toxicity value of more than twice that of the original. This compound caused no injury to the bean plants. Other experimental poisons had increased toxicity value, but were not safe to use, because they caused injury to the bean plants. These tests indicate that this compound has been very materially improved. While it can not be said to be better than the standard recommendation for the insect, it has the possibilities of making a good insecticide. Tests will probably be continued during the next season.

Tomato Fruit Worm

Our work on this project during the year again indicated that more than half of the spoilage of tomatoes by the fruit worm may be prevented by applications of poison, either as a dust or as a liquid spray. As in previous years the plants which were sprayed with poisoned liquid Bordeaux mixture remained green and bearing later in the season and gave a larger total yield of acceptable fruits,—although dusting is the quicker and easier method of application.

We find that other species of “worms” closely related to the fruit worm yet not that species, often eat into the tomato fruits and are thus responsible for some of the loss usually attributed to the fruit worm.

This season we had several plantings of corn near the tomatoes and as the fruit worm of the tomato is the same insect as the earworm of corn (and also the same as the bollworm of cotton) we had unusual opportunities for the study of the pest. We found corn to be attacked much more heavily than the tomatoes, indicating that as between these two the corn is much preferred, which in turn points to its possible usefulness as a trap crop for the protection of tomatoes.

We found that the eggs of the moth (on corn silks) were much attacked by egg-parasites (*Trichogramma* sp.) which we especially

noted in 1926 with regard to eggs on the foliage of tomatoes. It seems that these extremely small egg-parasites are one of the most beneficial of the natural factors which tend to hold down the increase of this destructive insect.

More definite data were secured upon the life history of the fruit worm than in the preceding years. Accurate counts were kept of all tomatoes picked from all rows, whether treated rows or untreated "checks", showing the number which were sound, spoiled by worms, and spoiled by rot, at each picking.

RESEARCH IN HOME ECONOMICS

Research in home economics in South Carolina during the fiscal year ended June 30, 1928, has brought to light facts which have an important bearing upon the physical, economic, and social conditions obtaining in the homes of the areas investigated. Bulletins are now being written which summarize conditions found in these two surveys. The first is a study of How Farm Families Use Their Leisure in four counties in South Carolina. The second bulletin is based on a study of The Care and Feeding of Children between One and Six Years of Age in four counties in this State.

The Amount and Use of Leisure

Interest in the study of amount and use of leisure is gratifying. Grade and high school teachers' clubs, both men's and women's, and social workers, state and county education and health authorities, and college teachers are alive to the significance of the findings. A growing awareness of the need of library service which shall reach the most isolated is one result of the facts found.

As a result of the report of the lack of reading matter available in the rural areas investigated, the South Carolina Division of the American Association of University Women has undertaken the promotion of county library service in this State as their major objective.

A spirit of inquiry is developing. How can worth-while use be made of the hours not spent in work? What does the environment offer that is interesting, wholesome, and enriching? How can the resources be developed? How can people be made socially aware of the other and of their common interests which may be furthered by concerted social effort? How can the full significance of the need of **recreation** as the renewing of mind and body through many types of activities be brought home to rural people? Many still think of **recreation** as just **recreation**, physical renewing only, or just play. But the whole matter applies to mind as well as body, eye to mind more than to body.

In this survey there were taken 355 white family records in-

cluding 1422 white individuals, and 47 negro family records involving 165 negro individuals.

This study indicates that there are a number of people in the areas surveyed with less than a high or elementary school education. There are many rural boys and girls in the teens and older who have left the day schools and will never return to them. These constitute a great company since 82.5 percent of the population of South Carolina is rural. Some of this group express a desire for vocational and cultural training. Others are apathetic who might be quickened by short courses of the right kind or the right reading matter through library extension service. Still others leave the country and villages because there is no adequate provision for games, contests, athletics, glee clubs, forums, debating societies, dramatics and for supervised in-door and out-door play. There is potential leadership in abundance. It is evident that the adults over thirty years of age in the country are disposed to accept life as they find it and that they are not awake to the opportunity which organization to provide recreation constitutes.

In the open country the need of provision for pleasure is evident. The little used possibilities await development.

This survey discloses a lack of modern equipment for woman's work in the rural home. The woman in the country has a right to a share in the new freedom from household drudgery which modern conveniences in the home bring. Such conveniences would mean a release for her in time which might well be spent in investigation and appraisal of the work and place of woman in the new social order and stimulate her to take her place as a part of it.

The need of religious leadership and education is great. There are few resident pastors in the open country under consideration. The families who have automobiles go sometimes to village or town churches. Some rarely go to church. The Sunday Schools in the open country are taught usually by the reverent middle aged, who with all their goodness, frequently fail to understand youth.

This study leads one to infer that closer cooperation between the education, agricultural, and health leaders who travel the country and local teachers and lay leaders would result in action which would meet some of the social needs.

The majority of the people interviewed preferred to live in the country, but most were out-spoken in their dissatisfaction with prevailing farm economic conditions. The answers to inquiries concerning reading matter available, church privileges, and social opportunities made it evident that little was being done to make rural life remunerative in all the values. And so youth migrates to the cities. The most dynamic and gifted are usually those who go. They go as soon as old enough to do so. They are raised at the expense of the

country but their best production years swell the wealth of the cities, and their potential social leadership is lost to the country.

Farm production per unit has been greatly increased. The organization of the industry of farming for distribution as efficiently as the other major industries are organized waits upon better schools for the young and better utilization of the leisure of the rural adult population for education as a continuous life process.

A wiser use of leisure is not a cure-all, but such use will go far in the solution of many rural problems. It will help in the preparation of rural youth for leadership and in a participation in legislation as well as in efficient food and fiber production and distribution.

A Study of the Food Habits of Pre-school Age Children in Relation to Their Health

This study of the food habits of pre-school age children was undertaken in cooperation with county health and education officers, home and farm demonstration agents, teachers, and leading citizens in the areas selected for the work. The school district was the geographical unit of the survey. The districts selected are believed to be representative of a cross-section of the rural people of the counties in which the districts are situated. The counties in which



Fig. 21.—Home economics in the grammar grades at the Dillon High School.

the survey was made are representative of geographical differences in South Carolina.

Information was secured by visiting the homes of the children selected for the study and securing from the mother a record of the child's past food habits and an accurate account of what each child ate during a definite period while under observation. Physical examinations were held at convenient locations by cooperating physicians, dentists, and nurses.

A comparison has been made of the health and development of each child as found by the examining physicians and the standards for that age child as shown by the tables issued by the American Medical Association. These facts and those found by a study of the recorded food histories of these children, together with the information of the food in-take of each child for one week, furnish a basis for valuable deductions and show the need of reconstructed procedure.

Many facts are suggestive. Many of those interviewed think of quantity and not kind of food eaten. Not all of the children were getting milk; instead some were getting tea and coffee. Some of the parents realize the importance of milk for their children, but more do not and the children go without it. It is desirable that every



Fig. 22.—Milk is an important part of the daily diet at the home of S. H. Zimmerman, Guernsey breeder, Columbia, S. C. George and Millie Zimmerman.

rural family shall keep a milk cow. Green vegetables, fruits, tomatoes, and whole-grained foods are too little used, hence the iron shortage in the diet. The vitamins are not properly represented in amount nor kind. This is due to the deficiency in the diet of vegetables, fruits, milk, whole-grain cereals, and whole-wheat bread. Even the potato, an important source of vitamin C in low-cost winter dietaries, does not last the farm operator's family until spring and is not usually purchased.

But in some homes mothers are dietary wise. This picture shows two young South Carolinians who therefore bid fair to be "healthy, wealthy, and wise."

EXPERIMENTS WITH FRUITS AND VEGETABLES

In the diversified agriculture which is being developed in South Carolina as a result of the work of the Experiment Station and the Extension Service, fruit and vegetable crops are assuming greater importance from year to year. The total value of these crops produced in 1927 in this State was more than \$29,000,000. About one-third of this value represents the vegetables and fruit produced in the home gardens and orchards, the balance indicates the value of our commercial fruit and vegetable products. South Carolina now ranks fifteenth in the United States and fourth in the South in carlot shipments of fruit and vegetables.

As these crops increase in importance and we depend more upon them for maintaining our farm income, the need also increases for additional researches which will enable us to produce them more efficiently and more economically. There are many insect pests and plant diseases that are encountered when we engage in this type of intensive agriculture. Many cultural, rotation, and fertilizer problems must be worked out so as to develop the best practice. The research staff of the main station has been strengthened and plans are under way for adding men at two of our substations to meet these needs and help solve some of the most pressing problems. The work already under way along these lines has made satisfactory progress and is being continued.

Apple Pollination Studies

One of the important problems facing our apple growers is that of proper pollination so as to secure a crop. Many of our home orchards and some of the commercial apple orchards in the South have failed to bear because varieties were planted which were either self-sterile or poor pollenizers. Our research work indicates that apple varieties must be selected with care if we are to have any assurance that the trees will bear fruit when they reach bearing age. Preliminary results of this study were reported in our last annual report. The results this year bear out those already reported and in-

dicate that in this section Delicious, Winesap, Stayman, Arkansas, and Golden Delicious will not set fruit with their own pollen and that Early Harvest, Rome, and Red June set at least a part of a crop from their own pollen. Delicious, while self-sterile, is an effective pollenizer for Staymen, Arkansas and Winesap.

Fertilizer Experiments With Peaches

The cooperative experiments with peaches have been continued at McBee and at Gramling along the same lines as reported in the last report. During this season both of these tests were interfered with by an epidemic of bacteriosis. This was more prevalent in the Sand Hills section than in the Piedmont and the severity of the attack masked completely the difference resulting from fertilizer treatment in the orchards at McBee. In the test at Gramling the results were unsatisfactory on account of the prevalence of this disease, but there were some differences that could be traced to fertilizer. The high nitrogen plots did not lose their leaves to such a large extent as did the plots which were fertilized with phosphorus and potash or with small amounts of nitrogen. The plots which seemed to resist this disease most effectively were those to which sulphate of ammonia was applied in the early spring.

Variety Tests of Peaches

The past season all of the varieties planted in our young peach orchard bore a crop of fruit for the first time. Some of the yellow-fleshed free-stone varieties obtained from the New Jersey Experiment Station seem very promising, especially for the home orchard. Two varieties of the cling-stone peaches largely grown in California for canning also fruited. This fruit, however, did not come up to the size and quality found in the same varieties when grown in California. The individual fruits were only medium in size, had a very heavy pubescence and were poor in quality.

A few varieties also give promise of being valuable to follow the Elberta, having better flavor than Elberta and growing to as large size. The Weaver variety offers much promise as a peach of good quality for the home orchard. Its ripening season is about the same as that of Elberta but it is more highly colored and has better quality than the latter.

Phenological data are being obtained on our peach varieties in addition to notes on size, quality, etc. The main purpose of this test is to find a yellow free-stone peach of large size and good quality that will mature ten days or two weeks later than the Elberta.

Variety Tests of Grapes

For the past five years we have been collecting phenological data on varieties of grapes. Such data should be of interest to farmers in South Carolina in giving them an idea of the blooming

and ripening periods. In addition to the phenological data we are also keeping a record of yields.

In 1928 the length of the blooming period of the different varieties varied from five to 18 days. In some seasons the length of time the grapes remain in good condition on the vine after they have ripened is much longer than in others. For instance, in 1925 Niagara grapes kept in good condition on the vine for six weeks, while the past season they did not keep longer than 10 days. In 1925 there was almost no rain from the middle of July to the middle of September, while during the past season several unusually heavy rains occurred after the grapes had ripened.

Experiments with Asparagus

Fertilizers.—Figures representing three cutting seasons are now available in the asparagus fertilization work. One test is being conducted at Clemson College on a sandy river bottom soil and two cooperative tests are being made at Monetta in cooperation with Mr. J. E. Boatwright, whose soil is a sandy loam with clay subsoil, and Mr. B. R. Gantt, who has deep sandy soil. A study of the more interesting results obtained to date indicates that nitrogen, phosphorus, and potassium are all necessary if the largest and most profitable yields are to be obtained.

It seems from these results that the most profitable fertilizer treatment at Monetta is 200 pounds of nitrate of soda applied before cutting, followed by one ton of 7-5-5 after cutting. At Clemson College, one ton of 7-5-5 applied after cutting has given the best results. Although two other treatments have given slightly larger yields at Clemson College, the differences are not great enough to make these treatments advisable.

The small increases which one and one-half tons of 7-5-5 have given as compared with one ton of the same fertilizer at both Monetta and Clemson College would not pay for the cost of the extra fertilizer. In the light of these results the practice, followed by some growers, of using excessively large amounts of fertilizers on asparagus may well be questioned.

Application of the fertilizer after cutting has given consistently better results than when it was applied before cutting.

Time of Cutting.—In California it has been shown that asparagus could be cut one year after planting without affecting the subsequent performance of the plants. In a test at Clemson College one half of each of a series of fertilizer plots has been harvested for four seasons and the other half for three seasons. The yields from these plots, while not entirely consistent, show on the whole a small difference in total yield to date in favor of the plots cut for three seasons. Where asparagus is grown under conditions similar to those prevailing in this experiment there is doubt as to the advisa-

bility of cutting it the first year after planting. While little has been lost by it so far, there has been no benefit derived. During the past season the yields from the two series of plots were approximately the same, so that any depressing effect which the cutting first year after planting may have had has apparently been overcome.

Distance of Planting.—During three seasons (1926-27-28) the following average yields were obtained for the different distances of planting asparagus:

Distance of planting	Average yield per acre, three years
3' x 2'	2132 lbs.
4' x 2'	1773 "
5' x 2'	1899 "
6' x 2'	1677 "
8' x 2'	1279 "

According to these figures, the closest planting has given the largest returns. Whether asparagus will endure such close planting as 3 x 2 feet over a period of years and still maintain proportionately high yields of spears of desirable size remains to be seen. The 4 x 2 feet planting exhibits an inconsistency which has not been explained. The greatest distance of planting is evidently too wide for high yields.

Fertilizers for Irish Potatoes

The results of six years' experiments with various fertilizers for Irish potatoes at Clemson College and Summerville and four years' experiments at Florence show that a complete fertilizer is necessary for best results. At all three stations one ton of a complete fertilizer seems to be a sufficient application. Although there were increases in yield when one and a half and two tons were applied, the increase due to the larger application was not sufficient to pay for the extra fertilizer and for applying it. In these experiments more variation in the nitrogen requirement on the different soils occurred than with either potash or phosphorus.

At Clemson College the experiment has been planted in a sandy river bottom soil seldom subject to overflow and in a medium fertile condition. At Summerville the soil used was a Norfolk sandy loam soil very deficient in fertility, while at Florence the soil was Orangeburg sandy loam and in a better state of fertility than that at either of the other two places.

This experiment included both wet, dry, and normal years. During the normal and wet years better results were, of course, obtained from the fertilizers than during the dry year.

At Clemson College 5 percent nitrogen has produced the most

profitable yields. At Florence 3 percent was sufficient while at Summerville, 7 percent produced the highest yields. The latter was to be expected in view of the poor soil used at Summerville.

In regard to phosphorus, it seems that 5 percent is a sufficient quantity at all three stations. While higher percentages have increased the yields in some cases, the increases have not been large enough to be significant.

With potash, 7 percent seems to be the right amount at Clemson College and Summerville, while 5 percent has given good results at Florence. The increased yields obtained with larger amounts are not sufficiently large to be significant or profitable.

EXPERIMENTS WITH POULTRY

The Poultry Division is in its second year. The work of increasing and improving the flock has continued. Cost of egg production and the cost of raising pullets through the use of home-grown and home-mixed rations has been studied. Feeding experiments in the use of cotton seed meal as a protein supplement and barley meal as a substitute for corn meal for laying hens are under way. Work on the preservation of eggs and lice control are also being conducted in a limited way.

In the original flock of Single Comb White Leghorn hens and pullets trap-nest records show 71 birds with records of 200 eggs and over. During the present year approximately 300 pullets, or one-third of the birds of this variety placed in the laying houses will complete the year with records of 200 eggs or better. The high egg record to date is 272 eggs. Flocks of the Single Comb Rhode Island Red and Barred Plymouth Rock varieties have been added. Records to date indicate that approximately 21 birds of the Rhode Island Red variety and 37 birds of the Barred Plymouth Rock variety will make yearly records of 200 eggs or better. For all experimental purposes it is important that the flock be standardized for both type and high production. This we are endeavoring to do.

A study of the cost of egg production from the records kept on the flock of White Leghorn hens and pullets showed a feed cost of 14.4 cents per dozen. Simple home-grown feeds and home-mixed rations were used throughout the year.

Germinated oats were fed at the rate of two pounds daily per each 100 hens during the winter months.

During the year each bird in the laying house consumed an average of 40.2 pounds of grain, 32.3 pounds of mash, 2.99 gallons of milk and 3.07 pounds of shell.

Studies on the cost of producing pullets showed that it required 88.5 cents for each pullet placed in the laying house.

Investigations are under way to compare cottonseed meal with meat scraps as a source of protein for laying hens. Studies are be-

ing made as to the influence of these two sources of protein upon egg production, fertility and hatchability of eggs, and growth and development of chicks produced.

Fertility and hatchability records show good fertility from all pens but poor hatchability from the pens receiving cottonseed meal. Eggs from the hens receiving cottonseed meal alone showed the poorest hatchability.

From the results of this trial it is concluded that cottonseed meal as the sole protein supplement would not be satisfactory for breeding stock.

Data on egg production and on the growth and development studies of the chicks hatched from the pens are not available at this time.

A feeding trial is under way to compare ground barley with ground yellow corn in the mash for laying hens. Since barley is becoming more and more important as a grain crop in this State its use in poultry rations would be desirable if satisfactory results can be obtained.

Trials to date with "Black Leaf 40" for lice in poultry show it to be entirely satisfactory. It has a decided advantage over the dusting method in that the birds do not have to be handled. The "Black Leaf 40" is applied to the roosts late in the afternoon. The fumes penetrate the feathers of the birds during the night and kill the lice.

CLEMSON COLLEGE FARMS

About 600 acres of the 1,620 acres owned by Clemson College at Clemson College, South Carolina, are being used for experiments and for producing feeds for the livestock on experiments conducted here at the College. Approximately 300 acres are used for pasture, and the remainder comprises the Clemson College campus. Of the 600 acres in cultivation, approximately 200 acres are used for numerous experiments conducted on an acre basis or less, and reported elsewhere by the divisions in charge. The remaining 400 acres of cultivated land are used for producing feeds for the experimental herds of hogs, sheep, beef cattle, and dairy cattle, and where the land is suitable, for experiments with crops on a larger scale. The principal crops grown by the Farms Division are corn, small grain, hay, and cotton. On most of these crops some form of research work is being conducted, some of which is briefly discussed in the paragraphs which follow.

The Power Unit as a Factor in Production Costs

One of the major projects under the direction of the Farms Division is that in which the power unit is studied as a factor in the cost of production of cotton.



Fig. 23.—Five-horse multiple hitch used on Clemson College farms in 1928.

During the past few years Texas and some of the other South-western States have produced a large percentage of the total cotton crop in the United States. Realizing not only this fact, but that it is possible for these Western States to grow a much larger percentage of our cotton at a lower cost per pound than it is now being produced in the Southeast, it behooves us to look for a more economical method of producing this staple in South Carolina. In studying this phase of the problem we found that approximately 60 percent of the cost of producing cotton is expended for man labor; so in 1927 the Farms Division in cooperation with the Professor of Farm Machinery began some studies to determine, if possible, some method by which the cost of the production may be decreased. These studies are being made on 36 acres of land divided into four plots. Each plot was prepared, planted, and cultivated by a different power unit; plot one by one animal, plot two by two or more animals, plot three by tractor entirely, and plot four by a combination of the power units used in plots one, two, and three. From these studies we have found that by the use of machinery man labor can be materially reduced as is shown in the preparation of the seed bed and the planting of the crop. The one-animal power unit required 25.8 man hours to prepare and plant an acre, the two or more animal power unit 12.2 man hours, the tractor power unit 3.37 man hours, and the combination power unit 15.4 man hours. Several factors such as weather conditions, poor stands, and lack of proper implements enter into this experiment which have had much bearing on the data thus far obtained and we feel that the project should be continued at least another year before final results are published.

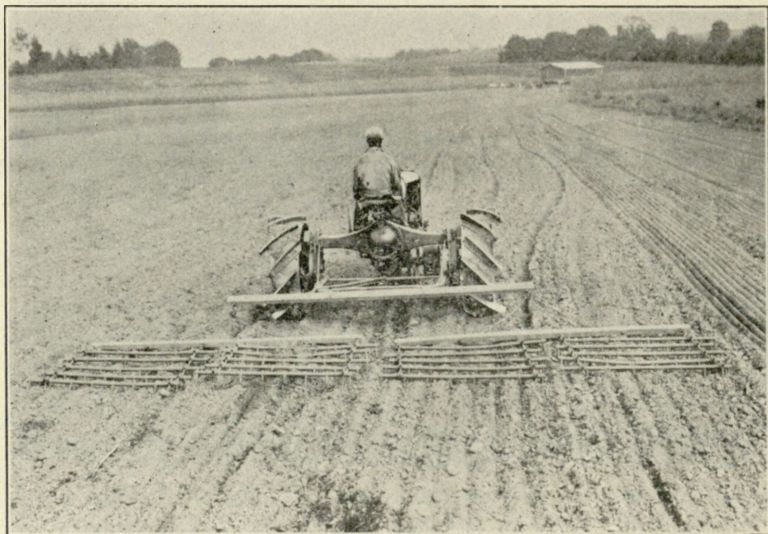


Fig. 24.—First cultivation for corn on Clemson College farms is made with this flexible peg-tooth harrow covering 30 acres per day.

Varieties and Value of Corn for Silage

Another experiment being conducted on a large scale by the Farms Division is that designed to study varieties and value of corn silage. It is a well known fact that silage is very essential for dairy and other cattle in South Carolina during the winter months. And since there is no succulent feed of the same analysis for comparison in arriving at the value of this feed, we have made some studies to determine, if possible, the variety that will produce the largest yield, the best method of planting and the value per ton of corn silage based on the amount of grain and stalk contained in a ton of silage. For these studies three varieties were used: Douthit's Prolific, Cox's Prolific, and Virginia. Two plots of each variety were grown, one drilled $10\frac{1}{2}$ inches apart in 42-inch rows, and the other was check row planted four kernels in the hill 40 inches apart. One-half of each plot was cut for silage and the remainder cut and shocked until dry, after which the grain was harvested and the stalks weighed. It was noted that in each case corn planted in the drill made the largest yield of silage per acre, and in two cases the highest yield of grain. The highest yields of silage, both planted in the drill and checked were secured from Cox's Prolific. Douthit's came second and Virginia third. Douthit's Prolific planted in the check made the highest yield of grain, followed by Cox's Prolific both in the hill and

check and by Douthit's in the drill. It was found that the amount of grain contained in a ton of corn silage is from 5 to $5\frac{1}{2}$ bushels. The amount of stover contained in a ton of silage is equivalent in value to $1\frac{1}{2}$ bushels of corn when stover is given a value of \$12.00 per ton. The value of a ton of silage, then, based on the value of grain and stover, is approximately seven times the value of one bushel of corn.

Cover Crops for Soil Improvement

For the past eight years much attention has been given to the improvement of our uplands on the College farms, and we believe that the soil has been improved 75 to 100 percent. This has been done largely by the use of the winter cover crop. In one field of 30 acres (from 1921 to 1925) we were never able to produce more than

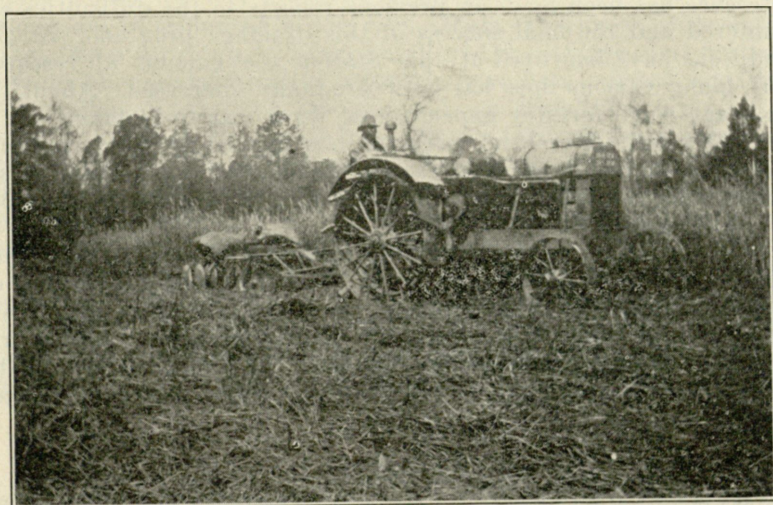


Fig. 25.—Good stage to turn under for improving the soil but hard to handle.

13 bushels of corn, or 600 pounds of seed cotton per acre. In the spring of 1926 a crop of vetch and rye was turned under and the field was planted to cotton. Since 1925 this field has been in cotton each year with a cover crop during the winter and has produced more than 1200 pounds of seed cotton per acre each year. Other fields have been improved by the same method. We are also using Austrian winter field peas as a winter cover crop and find it very excellent for this purpose. In short, our uplands today are yielding 100 percent more crops than they did in 1921 and the main reason for this increased yield is the cover crop.

For the past four years we have been growing sorghum cane for silage on the same field. This field consists of $3\frac{1}{2}$ acres of bottom land and 2 acres of upland. The yield per acre in 1925 was 11.8 tons, in 1926, 17.47 tons, in 1927, 18.86 tons, and in 1928 one acre of the upland which was not flooded by the overflow of the river in August produced silage at the rate of 31.21 tons per acre. This increased yield each year has been made possible by the use of cover crops, stable manure, and proper fertilizer.

THE COAST EXPERIMENT STATION

The Coast Experiment Station was organized largely for the purpose of demonstrating the possibility of draining and utilizing this low cut-over pine land for agricultural purposes. It was recognized at the outset that drainage was the outstanding problem. Reference has been made in previous reports to the difficulties encountered and the final success of this drainage program. As the conditions have improved at this Station the amount of research work along various lines has been gradually increased. About 15 years ago some forestry experimental work was undertaken and a little later definite research projects were shaped up with livestock. These, together with the field crop experiments, have resulted in securing valuable information which has been helpful in the development of this section.

The unusually heavy rainfall during the present season has made it very difficult to grow crops. Notwithstanding a rainfall of 46 inches from April 1 to October 1, fair yields of corn, cotton, ensilage, and hay have been produced. Excessive rains of course prevented maximum yields but the results of the experiments will be helpful because they indicate the success of different farm practices under these extremely wet conditions.

Field Crops

While livestock, forestry, and truck crop experiments are emphasized at this Station, we are still making an effort to carry some experimental work with the principal field crops. With cotton the variety test continues to be one of the more important features. This year 20 of the leading varieties and strains of cotton found in use in South Carolina were included in the test. It is interesting to note that two varieties produced 1800 pounds of seed cotton per acre even under the conditions prevailing this season. Humco-Cleveland 20-2 led with a yield of 1840 pounds, and Dixie-Triumph came second with 1800 pounds. College No. 1 and J. E. Wannamaker-Cleveland followed with 1770 and 1710 pounds respectively. The poorest variety in this test only made 1290 pounds, so there was a difference of 510 pounds of seed cotton per acre between the poorest and the best varieties, which emphasizes the importance of selecting

high yielding varieties for general planting. The cotton at this Station was fertilized with 750 pounds of 9-4-4 home-mixed fertilizer, and 100 pounds of nitrate of soda when the first indication of slowing up in growth was noted. All of the cotton received two light applications of calcium arsenate dust early in the season followed by later applications as weevil infestation made these necessary. While the early infestation was very heavy, good control was maintained until the latter part of August, at which time a fair crop of cotton was set. The cotton in the experiment on time of applying fertilizer was not planted until May 5 on account of the wet, cold weather. In spite of this late planting, the average yield on this work was 1378 pounds of seed cotton per acre.

The cover crop and rotation study with corn and cotton has been continued along the lines previously reported. In this test various winter legumes are used following cotton and the summer legumes are interplanted in the corn. This experiment is designed so that the cover crops will furnish all of the nitrogen that is needed, so no commercial forms of ammonia have been applied since the test was started except on the check plots which have no cover crops. The half of this test which has run through two years with a ton of ground limestone per acre has shown an increased yield and increase in earliness over the unlimed portion. The yield on this series of tests this year was approximately half of that which was secured on the variety test reported above.

The corn variety test has been very satisfactory except that the crop was greatly damaged by the tropical storm in September. This test includes a large number of the leading varieties of corn grown in this section of the State. Among these are Pee Dee No. 5, Garrick, Douthitt's, Goodman's Prolific, Hastings', and Lowman Yellow.

Livestock

Realizing that the cut-over pine lands of the Coastal Plains might be profitably used in livestock production, experiments were started several years ago on methods of developing pastures on this type of land. We now have several excellent carpet grass and lespedeza pastures at this Station. These have been developed from seed on areas that were sown in the early spring and grazed heavily so as to keep the other grasses from competing with the carpet grass. Besides the areas in the center of the farm which were developed early in the history of this Station, a 50-acre tract along the highway has received special attention during the last several years and is now rapidly developing into a fine sod of carpet grass. Fertilizer experiments are being conducted on parts of this area and this work will be enlarged as the areas seeded to carpet grass develop sod suitable for such experiments.

One of the problems at this Station in making pastures is to get

rid of the brush and shrubbery which grows luxuriously on these cut-over lands. We are using a herd of goats very effectively for this purpose. We now have over a hundred in the flock and find that by confining them on about 50 acres at a time they keep the bushes grazed so closely that the roots finally die. This practice materially reduces the cost of clearing and starting pastures.

The Aberdeen-Angus herd at this Station is improving from year to year and is being used to secure information on the value of pastures as well as on the cost of different methods of wintering beef cattle in this area. The herd was wintered during 1927-28 on



Fig. 26.—Angus herd on pasture at Coast Experiment Station.

sorghum silage, corn stover, and rough hay, supplemented by a small amount of cottonseed meal. The cost of wintering this herd was reduced by allowing them to graze on rye in the cultivated fields during January, February, and March. After April 1 the herd was turned on pasture and continued there throughout the season. Some of the old cows with suckling calves were fed a small amount of cottonseed meal in the early spring, but this was not necessary after the pastures were well under way. One feature of the beef cattle work that appeals especially to the farmers is that which enables us to sell the bull calves for breeding purposes. These are sold approximately at beef prices and some of them have developed into splendid herd sires. We sold nine bull calves during the past spring and could have sold a much larger number if we had had them. The pasture and cattle work is creating a great deal of interest which

indicates that our livestock experimental work is going to be of real value to the coastal section of the State.

The work with hogs has not been emphasized during recent years, but the increased interest in growing and fattening hogs in the Coastal Plains section during the past two or three years has caused us to enlarge this feature of the work at the Coast Station. We now have a good herd of Poland Chinas consisting of six sows and an unusually good boar of excellent breeding. We have supplied a number of farmers with boar pigs for grading up their herds and are continually having calls for breeding stock. An additional five acres of land has been cleared and this, together with 10 acres previously used for growing forage for the hogs, has been divided into three more lots and fenced. This enables us to have some forage growing practically all of the year for the hogs and increases the facilities for experimental grazing tests and feeding tests with hogs.

Forestry

Reforestation of the cut-over pine lands at the Coastal Plains is one of the big problems from an agricultural as well as from an industrial standpoint. Fifteen years ago experiments were started with a view of determining the best methods of seeding our different species of pine. Plantings included slash, long leaf, short leaf, and loblolly pines. These have now been under way long enough to give some interesting data as to methods of seeding and rate of growth. The slash pine is proving a very rapid grower and is the most promising species of pine grown in this area. It is not only an excellent timber tree but produces more turpentine than the long leaf pine. Mr. Kyzer, the Superintendent of this Station, has enlarged and improved the fire lines around the experimental forests and has kept fire off the entire place during the year. This permits natural reproduction on large areas of the land, and parts of the property where the fires have been kept out continuously over a period of years now have excellent stands of long leaf and loblolly pine. In fact, in some areas of the old pasture lands the pines have come in so rapidly that the value of the pasture has decreased.

Horticultural Crops

The most important work with horticultural crops at this Station is that with Irish potatoes. The source-of-seed test which has been under way here for a number of years was repeated with very satisfactory results. This year the Wisconsin seed made the highest yields, and Michigan ranked second, yields in these cases being 54 and 53 barrels respectively. Fertilizer experiments with Irish potatoes have been continued along the same line as reported previously and the best results were secured with one ton of 7-5-5 fertilizer

with the addition of 100 pounds of nitrate of soda as a side application. The yield in this case was $51\frac{1}{2}$ barrels while the same fertilizer without the side application of soda produced $45\frac{1}{2}$ barrels. Where a ton and a half of 7-5-5 was used without side application of nitrogen the yield was no greater than that produced by a ton of the same fertilizer with the additional 100 pounds of soda.

During the past few years there has been an insistent demand on the part of the truck farmers along the coast for research work on some of the vexing problems confronting the growers of truck crops. There are various insect pests and diseases that are causing large losses to these growers from year to year and in many cases the exact cause of the troubles and the remedies are not known. There are also many fertilizer and cultural problems peculiar to these crops which need to be worked out. A movement was started last year to establish a truck experiment station in Charleston County so as to provide facilities for researches which would meet this need. Funds have not been available, however, for this purpose, so the board of trustees finally decided to strengthen the organization at Drainland, build laboratories and green house there and add men to the staff to work along these lines. The Coast Station is only about 25 miles from the heart of the trucking section, so it is more economical to organize the work here than to establish a separate station. Funds for the purpose are included in the estimates submitted to the budget commission for the next year. This plan provides for a small field station in Charleston County for the purpose of providing facilities for field plot work and for growing the truck crops that the staff at Summerville will need in their research work. Charleston County will provide the field station.

The work with different fruit crops has been continued along the same lines. Some of the blueberries are making satisfactory growth while others are not proving satisfactory in this region. The northern strains have done rather poorly. Apples, grapes, and peaches are doing well.

General

The small grain crop of oats and rye was very good, and all of the land planted to these crops was later sown to peas for hay. Sufficient grain and hay have been produced to take care of the livestock on the farm and to provide seed for cover crops on all of the cultivated acreage during the winter. The agricultural teachers in this section of the State have taken an active interest in the work of the Station during the year. Their judging teams have held their district meetings here and they have been furnished with livestock and field crops for their contests. The number of visitors has in-traffic on Highway No. 2 on which the Station is located has result-

ed in increased interest in our livestock, forestry, and crops work. Many of the visitors stop for just a little while to see some special features of the work, but all of those who pass by get some impression of the splendid work that is being conducted.

THE PEE DEE EXPERIMENT STATION

Since the establishment in 1923 of the organization for research looking to control of the boll weevil, the Pee Dee Experiment Station has become one of our most important research units. The progress of this work has been reported from year to year and many of the practices in general use throughout the State have been developed here. During the season of 1928 Florence County and the Pee Dee section generally have suffered from exceedingly heavy rains and much of the experimental work has been seriously interfered with. The rainfall at the Pee Dee Station from January 1 to October 1 was 68 inches. The average for this period is 39 inches. The results secured under these conditions, therefore, would not be worth a great deal alone, but when combined with results from other seasons they serve to complete the picture in a way that will be quite helpful in making recommendations for similar seasons in the future.

Boll Weevil Studies

On account of the heavy weevil damage experienced in 1927 and the abundance of weevils in the field at the end of that season, it was decided to renew some of the experimental work which was conducted at this Station several years ago and which had been temporarily discontinued. Through cooperation with the Office of Cotton Insects of the United States Bureau of Entomology Mr. F. F. Bondy was transferred from Tallulah, Louisiana, to Florence to have direct charge of these several lines of work in cooperation with our staff at the Pee Dee Station. The work this year has been organized along three lines: (1) weevil hibernation, (2) study of weevil activities in the fields throughout the season, and (3) poison tests on farms in Florence County.

Weevil Hibernation Studies.—The weevil hibernation studies have been continued along the lines reported during the past few years. Eighteen thousand five hundred weevils were placed in cages between September 1 and October 31, 1927. As has been our custom, weevils were collected at different times during this period in order to secure additional data on the influence of the time of placing weevils in hibernation on the mortality during the winter. Four thousand weevils were placed in cages between September 2 and September 23 and none of these survived. Of the 2,000 weevils placed in hibernation between September 23 and October 1, 12 survived. Of the 2,000 placed in cages between October 7 and 15, 36 survived.

Of the 2,000 placed in hibernation between October 15 and November 1, 35 survived. These results check rather closely with those secured during previous seasons and indicate that where the crop is early enough and can be picked out in time it would be of very great advantage to destroy stalks and force the weevil into hibernation during September.

Another important point in these hibernation studies is with reference to the time that the weevils emerged in the spring. Of the 18,500 weevils placed in hibernation, 286 came out alive. Of these 88 emerged between the first and thirty-first of March, 91 during April, 87 during May, and 20 during June, between the first and seventeenth. No weevils emerged this year after June 21.

It will be recalled that in the spring of 1927 weevils continued to come into the fields from hibernation until after the first of July. During the season of 1928 emergence seems to have been completed by about the middle of June. May and June were relatively cold, wet months and cotton grew very slowly. As a consequence large numbers of the weevil died before cotton squares were big enough to become infested. This probably explains why the weevil population in the field decreased during June and first half of July. Counting all of the weevils placed in hibernation and the total number that emerged, the percentage of emergence was 1.54. The natural survival was probably larger than this because it will be noted that very few of the weevils that were placed in cages in September lived through the winter. In addition to this, 3,500 of the total included were placed in cages with different kinds of shelter and some in cages with no shelter at all. The number of survivals in these cases was smaller than the average and this served to bring down the total percentage.

Weevil Activity in the Fields.—We have realized that one of the most difficult features of the standard poisoning methods developed for controlling the weevil is the difficulty of getting farmers to keep up with the weevil activity in their fields and begin their poisoning at the proper time. We have for several years made field studies of weevil activity and weevil movement in order to accumulate information which might enable us to make some general predictions as to what might be expected. This season this matter was carried further and Mr. Bondy selected 65 farmers in 10 different counties representing the various farming districts in the State for making observations. These points were visited once each week and at the end of the week a report was made of the weevil activities on these farms as well as at Florence and Summerville and Pontiac. These were sent to Clemson College on Saturday of each week. Reports were also received from some of the county farm agents. Based upon this information, a statement was given out to the press on Monday of each week indicating the weevil infestation and suggesting what might be expected during that week.

A study of the data collected in this way shows that throughout the State the weevil came out in abundance during May and early June and that the population in the field decreased rather rapidly from the middle of June to about the middle of July, after which the weevil began to increase in the fields.

We believe that this kind of work will prove to be a valuable service to the farmers and we hope from it we might get information that will enable us to make predictions which will guide the farmers in their poisoning and other control measures.

In order to check up on the value of destroying the stalks in the fall of the year, we cooperated with County Farm Agent J. M. Napier in Darlington County and a group of farmers from that county who had destroyed their stalks in certain school districts very thoroughly during October, 1927. Weevil population studies and infestation records were kept on a number of farms in this area where stalks were destroyed and of a number of similar farms in other areas where the stalks were not destroyed. The record shows that the weevil population was smaller in the areas where the stalks were destroyed; the difference, however, was not as great as might have been expected. This we think is due to the fact that stalks were not destroyed until the middle or latter part of October and possibly many weevils had already gone into hibernation at that time.

The study of weevil movement by means of trap screens was continued along the same lines as reported before, and it was found that the greatest movement of weevils from field to field was from about August 19 to September 1. As early as August 9 weevils began to move from fields of early cotton that were completely infested by that time. One trap screen on the Pee Dee Station farm caught one hundred eighty-three weevils between August 19 and September 1. After this time the weevils came in such abundance from fields that had not been poisoned that additional applications of poison proved of little value.

Poison Tests.—On account of the large number of weevils in the field in May and early June it was decided to repeat some of the poison tests which had been discontinued. Eleven tests of this kind were therefore planned and carried through the season on farms at different points in Florence County. In some of these tests two applications of 1-1-1 calcium arsenate-molasses mixture were made and on some plots four applications were made, and these treatments were compared with check plots which were unpoisoned and in some instances with plots dusted throughout the season with calcium arsenate dust. Complete results from these tests are not available at this time and the season was such that it will be almost impossible to get comparative data as to yields from field plot work. A study of weevil activity and infestation during the season and ob-

servations made at the end of the season, however, indicate that the applications of early poison resulted in greater benefit for this season than has been the case heretofore. It is our plan to repeat these experiments next year and make an effort to check them very closely with other studies of weevil hibernation and weevil activities in fields at different points in the State. We are very anxious to get just as much information as possible on these points so as to furnish our farmers with accurate information as to the actual value of the different methods of applying poison for weevil control during different parts of the season.

Cotton Plant Investigations

The cotton plant researches at this Station during the past five years have resulted in developing cultural and fertilizer practices which are enabling us to produce cotton many seasons with little poison.

Spacing Tests.—Probably the most important of the cotton plant studies has been the spacing tests. The careful studies which have been made of the fruiting habits of cotton plants when spaced different distances apart in the row have revealed the fact that cotton plants placed six inches apart in the drill will fruit just as rapidly early in the season as those planted two feet apart. Where we average one stalk every six inches in four-foot rows it takes only about four bolls to the stalk to make a bale of cotton to the acre. During good fruiting weather in the early summer a plant will put on four to eight squares in 10 days. This work has proven, therefore, that a large number of stalks per acre will insure a full crop early in the season if conditions are at all favorable. Where the plants are spaced further apart, it takes a much longer time to set full crop of fruit and the danger from boll weevil damage or from seasonal injury is greatly multiplied. Several tests this year were planned along the same lines as those of previous seasons, but owing to the exceptional weather conditions little accurate data could be secured from them.

Variety Tests.—In our variety tests we have conducted each year tests where the weevils have been controlled by thorough poisoning and have conducted another variety test on a different part of the farm where no weevil control methods were applied except the usual spacings and cultural practices and two applications made of molasses calcium arsenate poison. All of the variety tests were so badly damaged by rains and storms this season that the yields are worth very little. It is interesting to note, however, that in the test where no late-season poisons are applied some of the early and more rapid fruiting varieties produce a fair crop of cotton.

Time-of-Planting Tests.—In the time-of-planting tests the first

plantings were made March 23 and these were continued at intervals until May 12. Good stands were obtained in practically all cases, but the plants were killed by frost and by disease during the cold, wet weather to the extent that no more than 50 percent of the stands were retained in any plantings up to April 14. Previous to this season the best results have been obtained from plantings made between April 1 and 10.

Seed Treatment.—The seed treatment tests which have proved interesting and helpful during the past few years were continued this year but with very unsatisfactory results owing to cold wet weather in the spring. The treated seed germinated and came up more quickly and seemed stronger and more vigorous than the untreated seed, as has usually been the case. But the plants in all plots were so badly damaged during the heavy rains and cold wet weather in April and early May that no very definite results could be secured.

Fertilizer Placement Studies.—During certain seasons it has been observed that fertilizer placed in too close contact with cotton seed seems to retard germination and early growth of the seedlings. Some experiments were started this year in an effort to get definite information on this point. The fertilizer was put out in a number of different ways. In some cases it was placed so that it would come in close contact with the seed, in other cases it was put in the furrow as usual and stirred by a small plow, in other cases it was all put on as a side application, and in still other cases it was put on top of the ground before the land was bedded. Some differences were observed with these different treatments, but the season was so unusual that we hesitate to draw conclusions from one year's results.

Source, Amount, and Time of Applying Ammonia.—The experiments with sources of ammonia, with varying amounts of ammonia, and with the time of applying ammonia as top dressing were continued along the lines as reported last year, and while the excessive rainfall prevented proper growth and in some cases seemed to have prevented proper utilization of nitrogen, the results of the season are in pretty close accord with those previously reported. In a test to determine the best time for applying nitrate of soda as a side application the greatest benefit was secured from application made between the time the cotton was chopped and the time that it began to bloom.

Fertilizer and Rotation Studies.—The fertilizer and rotation studies with cotton, corn, and small grain at the Pee Dee Station which have been referred to in our reports as the Keitt plots show some rather unusual developments during this excessively wet season. In the rotated plots the checks which have received no fertilizer during the past 15 years gave very small yields. The yields of these have been gradually declining but have held up remarkably

well considering the fact that no fertilizer has been applied during the long period of years and that all of the fertilizer must come from the plant residues and the legumes in the rotation. The best yields this year came from the plots receiving 1,000 pounds of 8-4-4. In the series where we have planted cotton continuously for 15 years, the crop was exceptionally poor. Even where 1,000 pounds of complete fertilizer was applied per acre the yield was very small.

Abortion of Young Buds and Squares.—One of the most striking developments with cotton at the Pee Dee Station this season was the kind of trouble that was referred to in our annual report for 1924 as the abortion of young buds and squares. The small fruit buds that are just one to five days old turn brown and drop off.

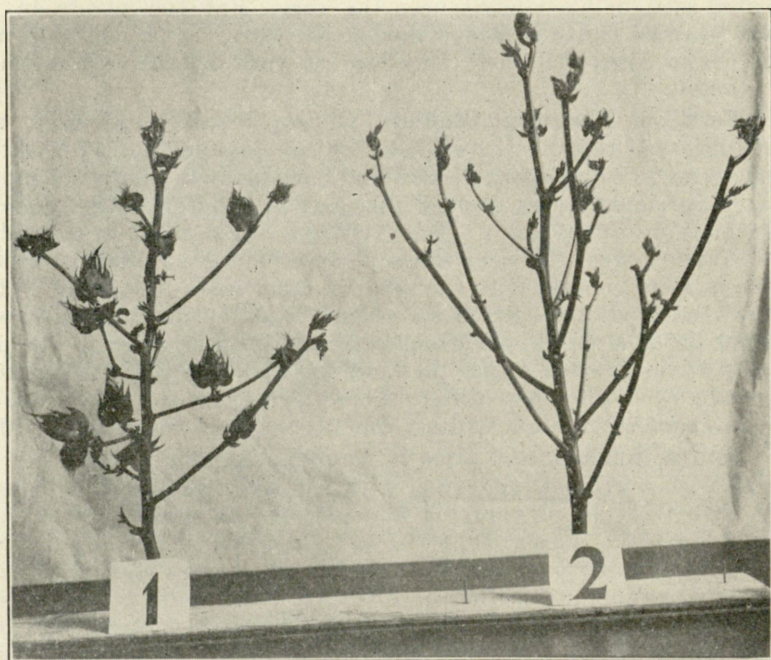


Fig. 27.—Stalk No. 1 has practically normal fruiting as compared with stalk No. 2 from which all early squares have aborted. Stalk No. 1 has one boll, 1 bloom, 28 squares. Stalk No. 2 has six squares.

This condition appeared again in 1928 at about the time cotton first began to fruit early in June. It persisted throughout the early part of the fruiting season and resulted in a very short crop in many areas throughout the Pee Dee section. The trouble is similar to that caused by the cotton flea hopper but repeated examinations by train-

ed entomologists failed to find these insects present. It seems rather definite that this abortion is due to some physiological condition and we are making a special study of the problem from the physiological standpoint and hope to get some definite information as to its cause.

Winter Cover Crop Tests.—We have learned from our rotation studies at the Pee Dee Station that the easiest way to keep land in a high state of fertility is with winter cover crops. During the fall of 1927 five different winter cover crops were planted on a number of small plots at the Pee Dee Station. Experiments were made with the different times of seeding and the different rates of seeding Hungarian vetch, monantha vetch, hairy vetch, Austrian winter peas, and Canada field peas.

With the exception of the Canada field peas all of these made good growth. The earlier the seed were planted the larger the crops grew until time to turn under in March. The Austrian winter pea proved to be the best of those included in this list and it will be planted on a large scale at this Station this winter.

Cotton Physiological Research

Dr. Armstrong and Dr. Albert have continued their physiological studies of cotton plants in the green house and in the fields. They have secured a great deal of interesting and valuable information on the growth and development of cotton buds and bolls and upon the nitrogen and carbohydrate materials in different parts of the plant during different stages of growth. The chemical composition of the different parts of the plant under different fertility conditions is being correlated with boll growth and with the shedding of bolls. Some interesting points have been brought out in connection with the relation of the consumption of nitrogen to these different activities and to the amount of nitrogen in the bolls during the different periods of growth. These studies are fundamental and a thorough knowledge of the influence of different factors on the behavior of the plant under different conditions will undoubtedly yield information which will enable us to improve the practices and remove some of the hazards in cotton production. The material is being prepared for publication in the *Journal of Agricultural Research* and other technical publications. All of the material will be brought together in bulletin form just as soon as the practical aspects have been worked out.

One point of special significance that might be mentioned in this report is with reference to the variation in the time required for bolls to reach full size. The studies made thus far show very clearly that the bolls that are set early in the spring grow much more rapidly than those which are set later. For instance, bolls collected on July 23 had an average green and dry weight per boll at

ages of 17, 18, and 20 days about 20 to 30 percent greater than those of the same ages collected on August 25. Full size of bolls is usually reached by the twenty-first day after blooming, but for those bolls which bloomed on July 31 twenty-four days were required to reach the maximum size, and for those that bloomed August 9 thirty days were required to reach the maximum size. The most rapid increase in diameter of bolls occurred between 9 and 13 days after blooming. Some additional information has been secured on the problem of cotton shedding and this problem is now being attacked from a number of different angles. Some of these promise to yield results of much practical importance.

Tobacco Experiments

Great interest has been manifested during the past few years in fertilizers and rotations best suited to the growth of tobacco. In 1927 a very complete series of fertilizer experiments was started at the Pee Dee Station with a view of securing information on methods of fertilizing this crop. We are studying there the different sources and amounts of potash as well as sources and amounts of ammonia best suited for maximum production of good quality tobacco. This series of experiments also includes some rotation studies in an effort



Fig. 28.—Fertilizer experiments with tobacco at Pee Dee Experiment Station.

to find what crop successions are best. All of the tobacco has not been sold for this season, so that the results are not complete. Observations made on the growing crop, however, indicate that there

are some very great differences in both yield and quality as a result of the different fertilizer combinations. During this rainy season the high potash plots have shown up remarkably well, and even those receiving excessive amounts of potash have shown great benefit from these increased amounts. Superintendent Currin is very much interested in this particular line of research, and his long years of experience with tobacco enable him to be of very great service to farmers interested in this field. He helped to prepare four extension circulars last year covering important features of tobacco production and has handled a large part of the correspondence that comes to the College on this subject.

General

The **corn variety tests** and **fertilizer experiments** are much better this year than the cotton work. The rains of course caused some damage especially at the time the corn was in bloom and the ears were being pollinated, but otherwise the crop is satisfactory and the usual data are being secured in the variety and in the fertilizer combination and rotation studies. As the corn has not been harvested at the time this report is written, the yields cannot be given.

The **experiments with peanuts and sweet potatoes** have been continued along the lines previously reported. This work is in co-operation with the Office of Horticultural Investigation of the Bureau of Plant Industry, and particular attention is devoted to breeding and fertilizer and rotation studies with sweet potatoes and peanuts. We have about 40 varieties of sweet potatoes growing and about 40 plats of seedling potatoes which have been developed from seed selections made in the Virgin Islands. These are forming the basis of selections which we hope might result in some improved strains of sweet potatoes.

Department Bulletin 1478 was published last year giving the results of our experiments with peanuts and this is available for general distribution from U. S. Department of Agriculture, Washington, D. C.

The **experiments with hogs** continue to be of interest to the farmers in this section. Where we have hogged-off corn and soybeans and supplemented this with tankage and mineral matter, the hogs have made most rapid and most economic gains. The tests at this Station also show that hogs can utilize green soybeans as forage; in fact, they make as rapid gains on green forage as they do on mature beans.

THE SAND HILLS EXPERIMENT STATION

At the time our last annual report was written, the United States Government had authorized the establishment of an experi-

ment station in the Sand Hills section of the State in cooperation with the South Carolina Experiment Station but no appropriation had been made from Federal funds with which to carry out this aim. At the session of the Congress held in December, 1927, an item was incorporated in an appropriation bill which passed the Congress and early in January \$25,000.00 became available from this source to be used for the establishment of such a station. In the general appropriation bill of the United States Department of Agriculture an additional amount of \$25,000.00 was appropriated for the maintenance of this cooperative station from January, 1928, to June 30, 1929. The funds which have been derived from this source are being used largely for operating costs, equipment, and salaries of the personnel, while funds which have been appropriated by the General Assembly of South Carolina have been used almost entirely for the erection of buildings and for permanent equipment since funds appropriated by the Federal Congress cannot be used for constructing buildings on property owned by the State.

Buildings and Equipment

The superintendent's residence, a two-story eight-room building, was completed in December, 1927, and has been occupied since that time by Superintendent J. A. Riley and his family. In April

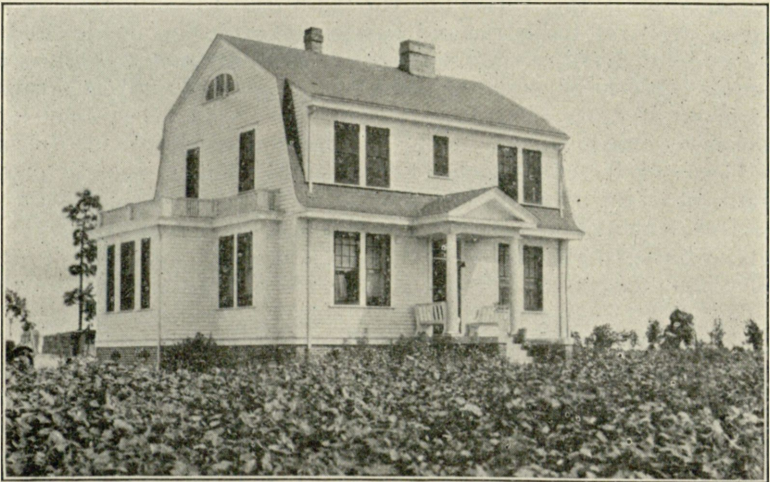


Fig. 29.—Residence of superintendent at Sand Hills Experiment Station.

work was begun on the two five-room cottages and the administration building. These cottages are modern and well built and are supplied with water and electric current. They have been com-

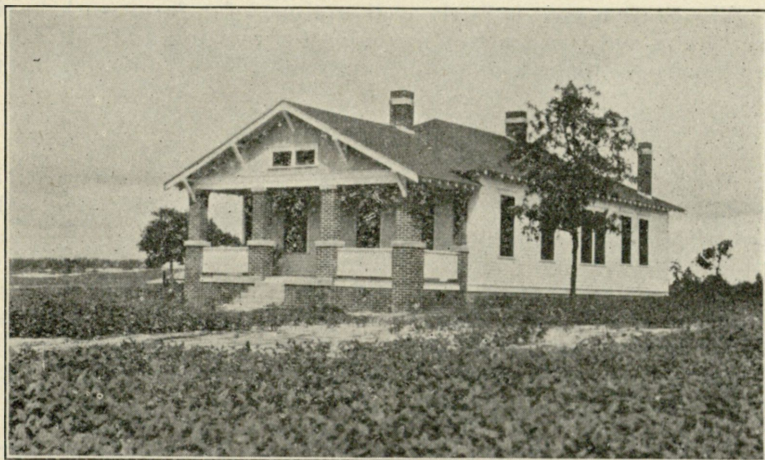


Fig. 30.—Five room cottage occupied by member of Sand Hills Station staff.

pleted and are occupied by members of the scientific staff. The administration building is a rectangular building 40 by 60 feet, constructed of hollow tile with brick veneer and is two stories in height. The partition walls are of hollow tile so that the building is virtually fireproof throughout. The first floor is built of concrete on the ground level. On this floor, space is provided for laboratories for fruit and vegetable work; sample and preparation rooms for soils and chemical analyses; rooms for the heating plant, showers and toilets; and an assembly room which is to be used for meetings with groups of farmers who visit the Station. The second floor is used for offices and laboratories for the research staff and will provide ample facilities for the work as planned.

During 1929 it will be necessary for us to build two more residences for members of the staff, dairy barns and barns for the work stock, and in addition some residences for laborers.

The Broad River Power Company has completed its power lines to the Station and is now prepared to furnish all of the current that is needed for power, for lights, and for the electrical equipment needed in the laboratories and in the homes. Telephone service has been provided by a toll line which the Southern Bell Telephone Company has constructed for this purpose. The Seaboard Air Line Railway has installed a spur track and has cooperated in improving our entrance across their tracks. The cooperation which these companies have evidenced by their providing these facilities is appreciated by all those interested in the work and responsible for its success.

The Station now is fairly well equipped for farm work having eight mules and two tractors available for plowing and cultivating. Small farm equipment and implements have been added during the year.

Organization of Research

The bill authorizing cooperative work at this Station provided for dairy and livestock work and forage investigations and other work which might be helpful in developing the agriculture in this region. Before a dairy unit could be established it was deemed desirable to conduct experiments in forage and feed production and in pasture development. It was realized also at the outset that soil fertility must be the basis of any development in this region. So, beginning early in the spring of 1928, projects were organized along these different lines.



Fig. 31.—Different species of *Crotalaria* at Sand Hills Station, 1928.

The cooperative relations with the United States Department of Agriculture have therefore included definite projects with the Office of Soil Fertility of the Bureau of Chemistry and Soils, with the Office of Forage Plant Investigation of the Bureau of Plant Industry, and with the Bureau of Dairying. In the soil fertility work Dr. J. J. Skinner and his associates have started a larger number of field plot experiments with different kinds of fertilizer and are assisting with other projects in rotation and green manure studies. The forage work of Dr. A. J. Pieters and Mr. H. N. Vinall has been conducted along several lines. A large number of different kinds of summer legumes have been grown in plots and others have been grown in smaller areas and gardens for the purpose of testing out their adaptability. Some of the more promising of the legumes have been grown in larger plots and are being turned under for green



Fig. 32.—Ootootan soybeans at Sand Hills Station, September 12, 1928.
One thousand pounds of ground limestone only applied.

manuring studies. Grass crops have also been started to test out the adaptability for pasture and forage in this section. Sixty acres of land have been cleared and seeded to carpet grass, lespedeza, Bermuda, and white clover. All of these have made very satisfactory growth and in practically all cases a splendid sod has developed which ought to furnish abundant grazing for next season. This pasture is being fenced and made ready for the dairy cattle when they are purchased next summer.

A part of the permanent staff for this work has already been selected. Mr. A. S. Laird has been stationed at this Station to handle the forage plant investigations. He has had good training and experience for this work and has taken hold of the problem in splendid shape. Dr. J. E. Adams, who has recently completed his training at Ames, Iowa, was secured by the Bureau of Soils and Chemistry to handle the biochemical aspects of soil problems and has been located here as a permanent member of the staff. All of the men of the United States Department of Agriculture who have had part in organizing the research work and in helping to develop this Station have cooperated most cordially and labored zealously to get the work started in the proper way.

Fertilizer Experiments with Crops

Two series of fertilizer experiments with cotton, corn, and small grain were started this year. The largest of these is the potash investigation which was made possible by a grant from the Agricultural and Scientific Bureau of the N. V. Potash Export My. This series of experiments includes about 20 acres divided into tenth-acre

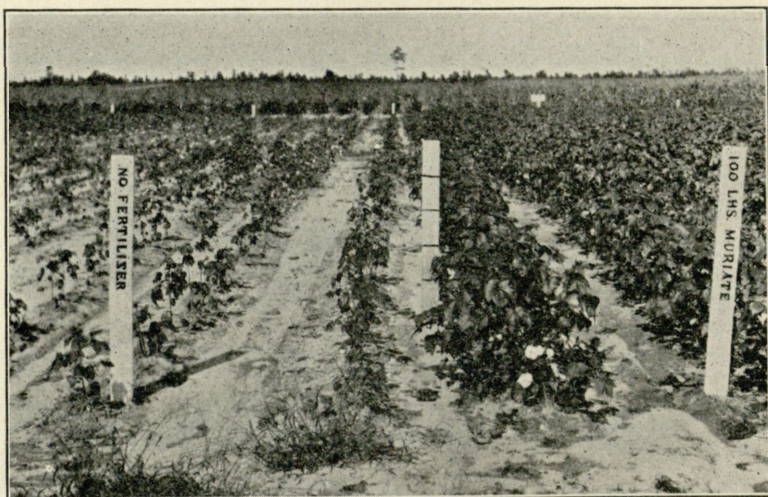


Fig. 33.—Potash experiment at Sand Hills Station, 1928. Plot on left received no fertilizer. Plot on right received 800 pounds of 8-8-0 and 100 pounds of muriate of potash per acre.

plots and planned so as to give information as to the influence of time, rate, method of applying, residual effect, and sources of potash when applied to cotton and corn and several other crops. This soil is very well suited to experimental work of this kind, as is indicated by some of the results this first year. On plots where no potash was used the yield of seed cotton was only 240 pounds compared with from 530 to 800 on different plots receiving potash. In another series where no fertilizer was used, only 140 pounds of seed cotton were secured per acre as compared with 893 pounds where application of 800 pounds of high grade fertilizer was used. Mr. R. B. Carr, our assistant agronomist, who has conducted experimental work with potash, also has some plots located on other soil types in Chester and York Counties. In other series of experiments tests are conducted to give information on the rate and time of applying nitrate of soda to corn, cotton, and oats, while in still another series comparisons are made between the different sources of ammonia applied to cotton.

Fruits and Vegetables

We have grown a large number of asparagus crowns and we transplanted to the field last winter several thousand of these on an area where extensive fertilizer experiments will be conducted with asparagus. About 2,000 peach trees were planted on virgin soil that had been cleared the year before and these are being prepared

for extensive fertilizer experiments with peaches. Preparations are also being made for extensive plantings of different varieties of grapes, both American and European. Some varieties have already been planted and have one season's growth. Others will be planted during the winter. Vegetables are being grown and fertilized in different ways with different combinations of iodine in connection with the study of iodine content of plants which is being conducted at Clemson College.

General

All of the 350 acres of cleared land at this Station has been planted to some kind of crop this season. The areas that are not used in different experiments have been planted to cotton or to corn and hay to produce feed for livestock. Excellent crops have been produced. All of this land is being sown to winter cover crops of different kinds, and certain areas are being laid off in plots for the purpose of comparing the value of the different winter legumes as soil improvement crops.

Many visitors have come to the Station from time to time during the year for the purpose of seeing and studying experimental work being carried on. The vocational teachers in this section of the State have visited the Station frequently with their students and these high school students of agriculture have taken an active interest in all of the experimental work under way. Visits from farmers from all sections of the State indicate the deep interest which is being taken in this Station by all of our people.

PUBLICATIONS

Gradually there is coming about a better understanding and greater appreciation of the research work of the South Carolina Experiment Station and for this reason publications reporting activities of the Station are now in very considerable demand. Consequently larger issues of bulletins and reports are becoming necessary. There has been during this fiscal year an especially noticeable demand for publications dealing with agricultural economics and with problems of fertilization and soil building. The increased number of publications from the Division of Agricultural Economics is meeting the demand for that sort of material.

The mailing list of the Experiment Station, which is being constantly revised by removals and additions, now contains around 6,000 names. Preparations are being made for a general revision of the list through the mailing out of revision cards to all names now on the list. To avoid waste of printed material the list is classified so that any given publication is sent only to those who have asked for information on the subject to which the publication belongs.

Publications Issued

During the fiscal year nine new publications were issued as follows:

- Bulletin 241, "Analysis of Commercial Fertilizers"
- Bulletin 242, "Small Grain Experiments"
- Bulletin 243, "An Economic Study of The Columbia Farm Trade Area"
- Bulletin 244, "Cotton Variety Experiments"
- Bulletin 245, "Cotton Fertilizer Experiments"
- Bulletin 246, "The Year Ahead in South Carolina Agriculture"
- Bulletin 247, "Studies of Farm Land Prices and Ownership"
- Bulletin 248, "Corn Variety and Fertilizer Experiments"
- Fortieth Annual Report, for the year ended June 30, 1927

Technical Papers

Armstrong, George M.

"The Toughness of Cotton Bolls in Relation to Age and Nutrient Supply as Measured by Pressure Test." *Journal of Agricultural Research*, v. 36, p. 1011-1025. June 15, 1928.

Buie, T. S.

"The Fruiting Habits of the Cotton Plant." *Journal of the American Society of Agronomy*, v. 20, No. 3, p. 193-201. March, 1928.

Collings, G. H., and Warner, J. D.

"Root Development of Cotton on Cecil Sandy Loam During 1926." *Journal of the American Society of Agronomy*, v. 19, No. 9, p. 839-842. September, 1927.

Eddy, C. O.

"The Place of the Native Persimmon in Nature in Relation to Other Plant Communities and to Certain Economic Insects." *Ohio Journal of Science*, v. 27, No. 4, p. 187-199. July, 1927.

The usual practice has been followed of writing news letters and special articles for The Weekly News Notes and for newspapers and agricultural journals, calling attention to the new publications of the Station and to older publications of new importance, and special articles have been prepared summing up various phases of research work for the benefit of the public. Articles by various members of the Station staff have also been prepared and given publicity through the Division of Publications, and otherwise. The material in these articles is, of course, based largely on the results of our research work as conducted during the fiscal year or before.

In this way the public is given a wider and better knowledge of the work which the Station does, and this in turn enables us to be of great service to the public. No opportunity is lost to remind the public of the need and value of agricultural research.

Publications Available

The following publications of the Station are available for general distribution as long as the supply lasts.

Bulletins

- Bulletin 191, "Results of Fertilizing Experiments with Cotton at the Clemson College Station."
- Bulletin 192, "Comparative Tests of Sources of Nitrogen on Coastal Plain Soils."
- Bulletin 193, "Results of Fertilizer Experiments Conducted at the Pee Dee Station."
- Bulletin 196, "A Chemical Process of Peeling Peaches."
- Bulletin 201, "Creosoting Fence Posts."
- Bulletin 213, "Rations for Weanling Pigs."
- Bulletin 214, "Comparison of Shelled Corn, Rice Meal and Velvet Beans for Fattening Steers."
- Bulletin 222, "Studies with Anthracnose Infection in Cotton Seed."
- Bulletin 223, "Progress Report on Studies on Boll Weevil Control Under South Carolina Conditions."
- Bulletin 224, "Analyses of Commercial Fertilizers."
- Bulletin 225, "Cotton Experiments at Florence."
- Bulletin 226, "Price Economics of What Farmers Sell."
- Bulletin 227, "Sources of Ammonia."
- Bulletin 228, "Soybean Forage for Hogs."
- Bulletin 229, "Analyses of Commercial Fertilizers."
- Bulletin 230, "Farming for Profits."
- Bulletin 231, "The Taxation System of South Carolina."
- Bulletin 232, "Experiments with Certified Irish Cobbler Potatoes."
- Bulletin 233, "Economic Conditions in the Lexington-Batesburg Section of South Carolina."
- Bulletin 234, "Protein Supplements to Corn in Dry Lot for Fattening Pigs."
- Bulletin 235, "The Cotton Flea Hopper."
- Bulletin 236, "The Mexican Bean Beetle."
- Bulletin 237, "House Fly Fumigation."
- Bulletin 238, "Some Effects of Late Defoliation in Cotton."
- Bulletin 239, "Economics of Producing and Marketing S. C. Peaches."
- Bulletin 240, "An Agricultural Production, Consumption, and Marketing Study in the Greenville, S. C., Trade Area."
- Bulletin 242, "Small Grain Experiments."
- Bulletin 243, "An Economic Study of the Columbia Farm Trade Area."
- Bulletin 244, "Cotton Variety Experiments."
- Bulletin 245, "Cotton Fertilizer Experiments."
- Bulletin 246, "The Year Ahead in South Carolina."
- Bulletin 247, "Farm Land Prices and Ownership."
- Bulletin 248, "Corn Variety and Fertilizer Experiments."
- Bulletin 249, "The Business Side of Dairying."
- Bulletin 250, "Analyses of Commercial Fertilizers."

Circulars

Circular 31, "Boll Weevil Investigations in 1923."

Circular 32, "Protecting South Carolina from Plant Diseases and Crop Pests."

Circular 33, "Poisoning the Boll Weevil in the Piedmont Section of South Carolina."

Reports

Thirty-Eighth Annual Report 1924-1925.

Thirty-Ninth Annual Report 1925-1926.

Fortieth Annual Report 1926-1927.

PROJECTS UNDER WAY

The following is a list of projects now under way:

Agricultural Economics Division

Studies of Farm Land Prices and Ownership in Anderson Area
Credit Study of the State
Farm Management Survey Study of Pee Dee Area
Farm Management Account Book Study of Piedmont Area
Livestock Economics Studies of Selected Areas
Marketing Demand, and Production Study of Charleston Farm Trade Area
Cotton Marketing Study of the State
Studies of Farm Prices and Farmers' Purchasing Power
The Farm Outlook in South Carolina

Agronomy Division

Cotton Variety Test
Corn Variety Test
Oat Variety Test
Wheat Variety Test
Rye Variety Test
Barley Variety Test
Soybean Variety Test
Barley Breeding (selection)
Cotton Breeding (selection)
Soybeans vs. Cowpeas for Hay
Pasture Seeding Experiment
Species and Variety Adaptation Test of Clovers, Vetches and other Winter Legumes
Introduction Test of New Plants and Crops
Time of Seeding Austrian Winter Field Peas
Winter-hardiness of Oats
Test of Winter Legumes Preceding Corn With and Without Lime
Seed Treatment of Cotton
Time of Planting Cotton
Cotton Spacing Test
Source of Nitrogenous Fertilizer to Cotton
Time of Application of Nitrogenous Fertilizer to Cotton
Rate of Application of Nitrogenous Fertilizer to Cotton
Source of Nitrogenous Fertilizer to Oats
Rate of Application of Nitrogenous Fertilizer to Oats
Time of Application of Nitrogenous Fertilizer to Oats
Rate of Application of Nitrogenous Fertilizer to Corn
Time of Application of Nitrogenous Fertilizer to Corn
Organic vs. Inorganic Sources of Nitrogen to Cotton
Fertilizer*Formula, Rate of Application, and Liming Test With Cotton in a Three-year Rotation
Fertilizer Formula Application to Oats
Fertilizer Formula Application to Wheat
Rotation Study—Cotton and Corn
Fertilizer Formula, Materials, and Rate of Application to Tobacco
General Fertilizer Formula Test with Cotton, Corn, and Small Grain in Rotation

General Fertilizer Formula Test with Peanuts
Effect of Summer and Winter Legume Crop where turned under for Soil Improvement (Cotton and Corn Rotation)
A study of the Effect of Fertilizer Placement in the Production of Cotton
Concentrated Fertilizer Experiments
Time of Applying Fertilizer to Cotton
Cotton Fruiting Studies
Factors Affecting the Oil Content of Cotton Seed
Investigation of the Effect of Various Sources of Nitrogen on the Chemical and Biological Changes in the Soil and the Influence of these Materials and Changes on the Composition and Yield of Crops

Animal Husbandry Division

Inbreeding Experiment with Swine
Protein Supplements for Fattening Hogs in Dry Lot
Cottonseed Meal as a Protein Supplement for Fattening Hogs
Hand versus Self-Feeding in Dry Lot and on Winter Forage
Rations for Fattening Hogs on Soybean Forage
Effect of Different Varieties of Soybeans on the Quality of Meat
Rations for Fattening Steers
The Effect of Breeding on the Quality and Palatability of Beef

Botany Division

A Study of the Factors Influencing the Growth and Development of Cotton Buds and Bolls
The Influence of Temperature on Germination of Cotton Seed and Growth of Cotton Seedlings
Effect of Debudding on the Growth and Fruiting of Cotton Plants
Forestry Experiments to Determine Methods of Seeding and Rate of Growth on Various Species
Plant Disease Survey

Chemistry Division

A Study of the Relationships Between the Content of Certain Mineral Elements of Farm-Grown Roughages and the Mineral Content of the Soil
A Study of the Factors Influencing the Iodine Content of Plants

Dairy Division

Preparation and Economic Uses of Hay in Feeding Dairy Cattle
Corn Silage as Compared with Sorghum Silage for Milk Production
Line Breeding and Out-Crossing as Systems of Breeding Dairy Cattle
Line Breeding of Holsteins
Official Testing of Dairy Cows in the State
A Study of the Influence of Different Feeds on the Growth of Dairy Heifers
A Study of the Normal Growth of Dairy Heifers
Photographic Studies of the Growth and Development of Dairy Animals
A Study of the Relation Between the External Form and the Internal Anatomy of the Dairy Cow and her Producing Ability
A Study of Contagious Abortion in Dairy Cattle

Entomology Division

Biology and Control of Mexican Bean Beetle
 Life History, Habits and Control of Bean Leaf Beetle
 Influence of Different Factors on Hibernation of Boll Weevil
 Biology and Control of the Cotton Flea Hopper
 Thrips on Cotton
 Biology and Control of Corn Bill-bugs
 Corn Weevil Studies
 Studies of the Southern Corn Stalk Borer
 Biology and Control of Tomato Fruit Worm
 Seasonal History and Control of Insects of Deciduous Fruits
 The Toxicity (killing-power) of Insecticide Materials
 Study of the Persimmon Psylla
 Studies of a Giant Root-borer in Apple Trees
 Faunal Survey

Home Economics Division

A Study of How Farm Families Use Their Leisure
 A Study of the Dietary Habits of Rural Children From Two to Six Years
 of Age in Their Relation to Health and Development

Horticultural Division

Fertilizer Tests on Bearing Peach Trees
 Variety Tests With Apples, Peaches, Grapes, Plums, Cherries, Pecans and
 Strawberries
 Tests of Sources of Irish Seed Potatoes
 Methods of Pruning For the Golden Delicious Apple
 Fertilizer Tests on Irish Potatoes
 Fertilizer Tests on Lettuce
 Pollination Studies with Apples
 Adaptation Studies of Blueberries
 Asparagus Fertilizer Trials
 Cost and Efficiency of Dusts for Controlling Insects and Diseases in the
 Home Orchard

Poultry Division

Cost of Egg Production
 Cost of Raising Pullets
 Comparison of Hatching Date for White Leghorn Pullets
 Comparison of Meat Scraps and Cottonseed Meal for Laying Hens
 Comparison of Ground Barley and Ground Yellow Corn in the Laying
 Mash
 Study of an Oil Coating Method for the Preservation of Eggs at Medium
 Temperature
 Study of "Black Leaf 40" as a Control of Poultry Lice

SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION

In Account With

THE UNITED STATES APPROPRIATIONS, 1927-28

		Hatch Fund	Adams Fund	Purnell Fund
DR.				
To balance from appropriations for 1926-27-	\$	0.00	\$ 0.00	\$ 0.00
Receipts from the Treasurer of the United States, as per appropriations for fiscal year ended June 30, 1928, under acts of Congress approved March 2, 1887 (Hatch Fund), March 16, 1906 (Adams Fund), and February 24, 1925 (Purnell Fund)		15,000.00	15,000.00	40,000.00
CR.				
Abstract				
By salaries -----	1	\$ 8,433.30	\$11,038.37	\$24,848.28
Labor -----	2	2,293.02	1,499.76	5,603.13
Stationery and office supplies	3	59.35	114.60	334.06
Scientific supplies, consumable	4	96.41	204.66	306.45
Feeding stuffs -----	5	600.00		693.67
Sundry supplies -----	6	690.38	246.50	418.04
Fertilizers -----	7	400.00		
Communication service -----	8	103.51	46.73	179.20
Travel expenses -----	9	238.35	18.96	5,001.73
Transportation of things -----	10	88.04	30.94	59.74
Publications -----	11	971.64		941.84
Heat, light, water and power	12	17.82	382.30	
Furniture, furnishings, fixtures -----	13	236.96		626.10
Library -----	14	328.72		
Scientific equipment -----	15		1,113.16	783.02
Livestock -----	16			
Tools, machinery, appliances	17	323.16	154.02	204.74
Buildings and land -----	18		150.00	
Contingent expenses -----	19	119.34		
Balance -----		0.00	0.00	0.00
TOTAL -----		\$15,000.00	\$15,000.00	\$40,000.00

WE, THE UNDERSIGNED, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION for the fiscal year ended June 30, 1928; that we have found the same well kept and classified as above; that the balance brought forward from the preceding year was \$0.00 on the Hatch Fund, \$0.00 on the Adams Fund, and \$0.00 on the Purnell Fund; that the receipts for the year from the Treasurer of the United States were \$15,000.00 under the Act of Congress of March 2, 1887, \$15,000.00 under the Act of Congress of March 16, 1906, and \$40,000.00 under the act of Congress of February 24, 1905, and the corresponding disbursements \$15,000.00, \$15,000.00, and \$40,000.00; for all

of which proper vouchers are on file and have been by us examined and found correct, leaving balances of \$0.00, \$0.00, and \$0.00, respectively.

AND WE FURTHER CERTIFY that the expenditures have been solely for the purposes set forth in the acts of Congress approved March 2, 1887, March 16, 1906, and February 24, 1925, and in accordance with the terms of said acts, respectively.

(Signed) A. S. FANT, State Bank Examiner.

Attest:

S. W. EVANS, Treasurer, Custodian

SUPPLEMENTARY STATEMENT, 1927-28

Funds of The Experiment Station Other Than Those From Federal Sources

DR.

Sources of Funds

Sources	Balance from Previous years	Receipts for 1928	Total
1. State appropriations -----	\$	\$ 82,176.70	\$ 82,176.70
2. Sale of produce -----	—3,598.50	63,043.55	59,445.05
Total -----	\$—3,598.50	\$145,220.25	\$141,621.75

Classification of Total Expenditures From Supplementary Funds

Salaries -----	\$ 30,240.97
Labor -----	39,558.31
Stationery and office supplies -----	629.10
Scientific supplies, consumable -----	76.16
Feeding stuffs -----	14,759.96
Sundry supplies -----	7,637.01
Fertilizers -----	8,863.47
Communication service -----	755.48
Travel expenses -----	6,166.75
Transportation of things -----	1,148.54
Publications -----	1,309.71
Heat, light, water and power -----	2,922.25
Furniture, furnishings, fixtures -----	58.68
Library -----	77.30
Scientific equipment -----	0.00
Livestock -----	2,738.29
Tools, machinery and appliances -----	5,093.09
Buildings and land -----	17,214.88
Contingent expenses -----	45.05
Unexpended balance -----	—2,326.75
TOTAL -----	\$141,621.75